

**BIRLA INSTITUTE OF TECHNOLOGY
MESRA
RANCHI, INDIA
CHOICE BASED CURRICULUM**

**Under Graduate Programme
Department of Mathematics**

Programme Outcomes

The graduates of this program are expected to:

1. Gain sound knowledge on fundamental principles and concepts of Basic Mathematics: calculus, differential equations, complex analysis, probability theory and their applications related to Industrial, Engineering, Biological and Ecological problems.
2. Exhibit in depth the analytical and critical thinking to identify, formulate and solve real world problems of science and engineering.
3. Be proficient in arriving at innovative solution to a problem with due considerations to society and environment.
4. 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.
5. Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc) relevant to professional practice and demonstrate through actions, the need for sustainable development
6. Be committed to professional ethics, responsibilities and economic, environmental, societal and political norms.
7. 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.
8. Develop written and oral communications skills in order to effectively communicate design, analysis and research results.
9. Be able to acquire competent positions in industry and academia as well.
10. Be able to acquire lifelong learning and continuous professional development.
11. 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.
12. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

COURSE INFORMATION SHEET

Course code: MA 103

Course title: Mathematics I

Pre-requisite(s): Basic Calculus, Basic Algebra

Co- requisite(s): ---

Credits: L: 3 T: 1 P: 0 C: 4

Class schedule per week: 3 Lectures, 1 Tutorial.

Class: BE

Semester / Level: I / First

Branch: All

Name of Teacher:

Course Objectives:

This course enables the students to understand

1.	Infinite sequences and series.
2.	Theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
3.	Multivariable functions, their limits, continuity, partial differentiation, properties and applications of partial derivatives.
4.	Integrals of multivariable functions viz. double and triple integrals with their applications.
5.	Properties like gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions.

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

CO1	Decide the behaviour of sequences and series using appropriate tests.
CO2	Get an understanding of partial derivatives and their applications in finding maxima - minima problems.
CO3	Apply the principles of integral to solve a variety of practical problems in engineering and sciences.
CO4	Demonstrate a depth of understanding in advanced mathematical topics.
CO5	Enhance and develop the ability of using the language of mathematics in engineering.

(MA 103) Mathematics I

Syllabus

Module 1: Sequences and Series

Sequences, Convergence of Sequence. Series, Convergence of Series, Tests for Convergence: Comparison tests, Ratio test, Cauchy's root test, Raabe's test, Gauss test, Cauchy's Integral test, Alternating series, Leibnitz test, Absolute and Conditional Convergence.

[9 L]

Module 2: Matrices

Rank of a Matrix, elementary transformations, Row - reduced Echelon form. Vectors, Linear Independence and Dependence of Vectors. Consistency of system of linear equations. Eigenvalues, Eigenvectors, Cayley - Hamilton theorem.

[9 L]

Module 3 : Advance Differential Calculus

Function of several variables, Limit, Continuity, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Chain rules, Jacobians and its properties, Taylor series for function of two variables, Maxima ó Minima, Lagrange's method of multipliers.

[9 L]

Module 4: Advance Integral Calculus

Beta and Gamma functions: definition and properties.

Double integrals, double integrals in polar coordinates, Change of order of integration, Triple Integrals, cylindrical and spherical coordinate systems, transformation of coordinates, Applications of double and triple integrals in areas and volumes.

[9 L]

Module 5 : Vector Calculus

Scalar and vector point functions, gradient, directional derivative, divergence, curl, vector equations and identities. Line Integral, Work done, Conservative field, Green's theorem in a plane, Surface and volume integrals, Gauss ó divergence theorem, Stoke's theorem.

[9 L]

Text Books:

1. M. D. Weir, J. Hass and F. R. Giordano: ThomasøCalculus, 11th Edition, Pearson Educations, 2008E.
2. H. Anton, I. Brivens and S. Davis, Calculus, 10th Edition, John Wiley and sons, Singapore Pte. Ltd., 2013.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. M. J. Strauss, G. L. Bradley And K. J. Smith, Calculus, 3rd Ed, Dorling.Kindersley (India) Pvt. Ltd. (P Ed), Delhi, 2007.
2. David C. Lay, Linear Algebra and its Applications, 3rd Edition, Pearson Ed. Asia, Indian Reprint, 2007.
3. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, 4th Edition, 2011.

COURSE INFORMATION SHEET

Course code: MA 107

Course title: Mathematics II

Pre-requisite(s):

Co- requisite(s): Mathematics - I

Credits: L: 3 T: 1 P: 0 C: 4

Class schedule per week: 3 Lectures, 1 Tutorial.

Class: BE

Semester / Level: II / First

Branch: All

Name of Teacher:

Course Objectives: This course enables the students to understand

1.	Various methods to solve linear differential equations of second and higher order.
2.	special functions viz. Legendre's and Bessel's and different properties associated with them.
3.	Diverse mathematical techniques for solving partial differential equations of first order and higher order, along with their applications in wave and heat equations using Fourier series.
4.	The theory of functions of a complex variable, complex differentiation and integration.
5.	About random variables and elementary probability distribution.

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

CO1	Investigate the occurrence of differential equations in science and engineering and use methods available for their solutions.
CO2	Gain an understanding on complex variable functions and using their properties in real life problems.
CO3	Construct appropriate probability models in solving real world problems.
CO4	Demonstrate a depth of understanding in advanced mathematical topics.
CO5	Enhance and develop the ability of using the language of mathematics in engineering.

(MA 107) Mathematics- II

Syllabus

Module 1: Ordinary Differential Equations – I

Linear differential equations, Wronskian, Linear independence and dependence of solutions, Linear differential equations of second and higher order, Operator method, Legendre's and Euler & Cauchy's form of linear differential equation, Method of variation of parameters.

[9 L]

Module 2: Ordinary Differential Equations – II

Ordinary and singular points of differential equation, Power and Frobenius series solutions. Bessel's differential equation, Bessel function of first kind and its properties. Legendre's differential equation, Legendre's polynomial and its properties.

[9 L]

Module 3: Fourier series and Partial Differential Equations

Fourier series: Euler formulae for Fourier series, Dirichlet conditions, Half range Fourier series.

Partial Differential Equations: Linear partial differential equations, Lagrange's method. Method of separation of variables and its application in solving one dimensional wave and heat equations.

[9L]

Module 4: Complex Variable-Differentiation & Integration

Function of a complex variable, Limit, Continuity, Differentiability, Analyticity, Analytic functions, Cauchy & Riemann equations. Harmonic functions, Harmonic Conjugate.

Cauchy's theorem, Cauchy's Integral formula, Taylor and Laurent series expansions. Singularities and its types, Residues, Residue theorem.

[9L]

Module 5: Applied Probability

Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, variance, moment generating function. Introduction to Binomial, Poisson and Normal Distribution.

[9L]

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, 4th Edition, 2011.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, McGraw Hill, 2004.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, 3rd Edition, Narosa Publishing, 2009.
5. R. A . Johnson, I. Miller and J. Freund: Probability and Statistics for Engineers, PHI.

- S. C. Gupta and V.K . Kapoor.: Fundamental of Mathematical Statistics, Sultan Chand and Sons.

Reference Books:

- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition ., Wiley India, 2009.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
- E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- G. F. Simmons, Differential Equations with Applications and Historical Notes, TMH, 2nd Edition, 2003.
- P. L. Meyer: Introductory Probability and Statistical Applications, Oxford & IBH.

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	3	2	1	1	1	1	3	3	2	2
CO2	3	3	3	2	1	1	1	1	3	3	2	2
CO3	3	3	3	2	1	1	1	1	3	3	2	2
CO4	2	2	3	3	1	1	1	1	3	3	2	2
CO5	2	2	3	3	1	1	1	1	3	3	2	2

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



**BIRLA INSTITUTE OF TECHNOLOGY
MESRA**

RANCHI, INDIA

CHOICE BASED CURRICULUM

Under Graduate Programme

Department of Chemistry

Program Outcomes

1. Demonstrate knowledge on fundamental principles including concepts and their applications related to chemistry.
2. Have ability for in depth structural and analytical thinking towards chemical science to conceptualize and analyze to improve the knowledge of chemical systems and its connections with natural and engineering sciences.
3. Have ability to design system components and chemical processes meeting all applicable consideration for public health, safety, cultural, societal and environmental considerations.
4. Have ability to investigate and analyze critical physicochemical and structural problem towards the development of appropriate solution.
5. Have ability to use modern lab equipment and relevant theoretical understand to perform measurements, experiments, design and analysis.
6. Be able to apply the awareness to assess chemical impact on societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional practices.
7. Exhibit understanding of theoretical & experimental perspective to solve societal and environmental issues (health, legal, safety, cultural etc.) relevant to professional practice.
8. Informed to professional ethics, responsibilities, economic, environmental, societal, and political norms.
9. Have ability to work as an individual, in a team or as a team leader, for project execution and to achieve the objectives.
10. Have ability in written and oral communications to effectively present the chemical system for product design and analysis.
11. Develop know-how in managerial capacity including cost design to acquire leadership position in chemical industry.
12. To develop interest, encouragement and aptitude for life-long learning and continuous professional growth.

COURSE INFORMATION SHEET

Course code: CH 101
Course title: Chemistry
Pre-requisite(s): Intermediate level chemistry
Co- requisite(s):
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week: 04
Class: B.Tech.
Semester /Level: I/First
Branch: ALL
Name of Teacher:

Course Objectives

This course enables the students:

1.	To create concept of Chemical bonding & Coordination Chemistry.
2.	To understand the basic 3D structure in organic chemistry including stereochemistry, aromaticity and reaction mechanism.
3.	To understand the reaction dynamics and to know different types of catalysis.
4.	To understand the modern techniques related to spectroscopy and structural characterization.
5.	To develop knowledge on the physical state and electrochemistry of molecules.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to explain the bonding in a molecular structure.
CO2	Able to explain the 3D structure, aromaticity and stereochemistry of organic molecules.
CO3	Able to explain the spectroscopic data for structural characterization of the molecules.
CO4	Able to predict the rate, molecularity and mechanism of a simple as well as catalytic reaction.
CO5	Able to interpret the phases of solid and the electrochemical behavior of the molecules.

(CH 101) Chemistry

Syllabus

Module I: Chemical Bonding

Ionic bond: Radius ratio rule, Born-Landé equation, Born-Haber cycle. *Metallic Bond:* valence bond and band theories, defects in solids, Werner's Theory, Bonding in Transition metal complexes, Ligands, coordination complexes, Ligand Field, Crystal Field Theory, Octahedral, Tetrahedral and square planar complexes, CFSE, Jahn Teller theorem, electronic spectra, magnetism, and isomerization in coordination compounds. [9L]

Module II: Organic Structure and Stereochemistry

Covalent bond: Lewis structure, Valence Bond theory, Molecular orbital theory, Molecular orbital of diatomic and polyatomic system, hybridization, conjugated molecules, Huckel molecular orbital theory of conjugated systems. Isomerism, Geometrical isomerism: *cisótrans* and syn-anti isomerism; Optical isomerism & Chirality; Wedge, Fischer, Newmann and Sawhorse Projection formulae and interconversions; E/Z, D/L, R/S nomenclature system; Conformational studies of ethane, n-butane, Cyclohexane. [9L]

Module III: Kinetics and Catalysis:

Order & molecularity of reactions: chain, parallel, Competing, Side, Consecutive reactions; Kinetics of Fast reactions, Characteristics of catalyst, types of catalysis, catalytic poison; Theories of catalysis; Acid base catalysis: including kinetics, Enzyme catalysis, Mechanism and kinetics of enzyme catalyzed reaction, Michaelis-Menten equation, Important catalysts in industrial processes; Hydrogenation using Wilkinsons catalyst, Hydroformylation by using Cobalt-catalyst, Phase transfer catalyst. [9L]

Module-IV: Spectroscopic Techniques

Absorption and emission Spectroscopy, Lambert-Beers Law, Principles and applications of UV-Visible, Factors influencing for UV-VIS spectrum; Rotational and Vibrational spectroscopy, Principle of FT-IR, and NMR spectroscopy; Modern techniques in structural elucidation of compounds by UV-VIS, IR, & NMR Spectroscopy. [9L]

Module V: Phase and Chemical equilibrium

Phase Rule: Terms Involved, Phase diagram of one component (Water) & two component (Pb/Ag) system & their applications. Law of chemical equilibrium, equilibrium constants and their significance, Weak and strong electrolytes, Standard electrode potential and its application to different kinds of half cells, EMF and its measurement and application, Batteries and Fuel Cells, Chemical and Electrochemical corrosion, Factors affecting the rate of corrosion. [9L]

Text books:

1. Huheey, J. E., Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Pearson.
2. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Seventh Edition, Pearson
3. Atkins, P. W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.

Reference books:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier (2009).
3. William Kemp, Organic Spectroscopy, 3rd Ed., 2008 Macmillan.

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

POs met through Gaps in the Syllabus : NA

Topics beyond syllabus/Advanced topics/Design : NA

POs met through Topics beyond syllabus/Advanced topics/Design

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

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	10+10
Teacher's assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
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 of Course Outcomes onto Graduate Attributes

Course Outcome #	Graduate Attributes											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2		3	3	3		3	2	2		3
2	3	3		3	3	3		3	2	2		3
3	3	1		2	1	2		3	2	2		3
4	3			3	2	2		2	2	2		3
5	2	3		3	3	3	3	2	2	2		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	CD1 and CD2
CD2	Tutorials/Assignments	CO2	CD1 and CD2
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects	CO4	CD1 and CD2
CD5	Laboratory experiments/teaching aids	CO5	CD1 and CD2
CD6	Industrial/guest lectures	-	-
CD7	Industrial visits/in-plant training	-	-
CD8	Self- learning such as use of NPTEL materials and internets	-	-
CD9	Simulation	-	-

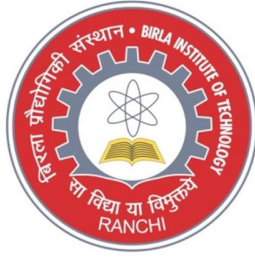
Course code: CH 102
Course title: Chemistry Lab
Pre-requisite(s): Intermediate level Chemistry
Co- requisite(s):
Credits: 1.5 L: 0 T: 0 P: 3
Class schedule per week: 03
Class: B. Tech.
Semester / Level: I/First
Branch: ALL
Name of Teacher:

Syllabus

1. Gravimetric estimation of Nickel by Dimethylglyoxime.
2. Quantitative estimation of Ca^{2+} and Mg^{2+} ions by complexometric titration using $\text{Na}_2\text{-EDTA}$.
3. To verify Bears Law using Fe^{3+} solution by spectrophotometer/colorimeter and to determine the concentration of a given unknown Fe^{3+} solution.
4. Separation of binary organic mixture by acid-base extraction and analysis using given FTIR and NMR spectrum.
5. Preparation of Diazoamino Benzene and report the melting point and yield of product.
6. Draw melting point-mass percent composition diagram for two component mixture and determine the Eutectic Temperature.
7. To study the kinetics of acid-catalyzed hydrolysis of ethyl acetate and to evaluate the value of the rate constant.
8. To determine the rate law for the reaction between iodide and hydrogen peroxide in an acidic environment and to determine the effect of a catalyst on the rate of reaction.
9. To determine the strength of the given strong acid by strong base Potentiometrically.
10. To determine the transition temperature of the given salt hydrate.
11. Qualitative detection of special elements in organic compounds.
12. To draw the pH-titration curve of strong acid vs strong base.

Reference book:

1. Experimental Physical Chemistry, By B. Viswanathan, P. S. Raghavan, Narosa Publishing House (1997).
2. Vogels Textbook of Practical Organic Chemistry
3. Experiments in General chemistry, C. N. R. Rao and U. C. Agarwal
4. Experimental Organic Chemistry Vol 1 and 2, P R Singh, D S gupta, K S Bajpai, Tata McGraw Hill



**BIRLA INSTITUTE OF TECHNOLOGY
MESRA
RANCHI, INDIA**

CHOICE BASED CURRICULUM

Under Graduate Programme

Department of Electronics and Communication Engineering

Program Outcomes

1. Demonstrate knowledge on fundamental principles and concepts, apart from the knowledge on various systems, standards and their applications related to Electronics and Communication Engineering.
2. Have ability for in depth analytical and critical thinking in order to conceptualize, analyze, design and improve different kinds of electronic systems and communication applications reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. Have ability to design system components and processes meeting all applicable consideration for public health and safety, cultural, societal and environmental considerations.
4. Have ability to investigate and analyze complex problems and development of appropriate solution.
5. Have ability to use lab equipment using modern tools and relevant simulation software to perform measurements, experiments, design and analysis.
6. Be able to apply reasoning informed contextual knowledge to assess societal, health, safety legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc.) relevant to professional engineering practice and demonstrate knowledge of and the need for sustainable development.
8. Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
9. Have ability to work as an individual, in a team or team leader, in a multidisciplinary team.
10. Have ability in written and oral communications to effectively communicate product design and analysis.
11. Develop know-how in project management and finance to acquire leadership position in industry.
12. Have and interest and aptitude for life-long learning and continuous professional development.

COURSE INFORMATION SHEET

Course code: EC 101

Course title: Basics of Electronics & Communication Engineering

Pre-requisite(s): N/A

Co-requisite(s): N/A

Credits: L: 3 T: 1 P: 0 C: 4

Class schedule per week: 04

Class: B. Tech.

Semester / Level: I/First

Branch: ALL

Name of Teacher:

Course Objectives:

This course enables the students:

1.	To understand PN Junction, diodes and their applications.
2.	To comprehend BJT, FET and their bias configurations.
3.	To grasp importance of feedback in amplifier circuits, op amp and its applications.
4.	To understand number system, Logic Gates and Boolean algebra.
5.	To apprehend fundamentals of communication technology.

Course Outcomes:

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

CO1	Explain PN Junction, diodes and their applications.
CO2	Appraise the BJT, FET and their biasing techniques.
CO3	Comprehend feedback in amplifier circuits, op amp and its applications.
CO4	Translate one number system into another, build circuits with Logic Gates, electronic components and OPAMP IC 741 and analyze the measurement results using CRO.
CO5	Appraise the fundamentals of communication technology.

(EC 101) Basics of Electronics & Communication Engineering

Syllabus

Module-1

Diodes and Applications: Introduction to PN junction diodes; Characteristics of semiconductor diodes: V-I characteristics, diode-resistance, temperature-dependence, diode-capacitance; DC & AC load lines; Breakdown Mechanisms; Zener Diode ó Operation and Applications; Diode as a Rectifier: Half Wave and Full Wave Rectifiers with and without C-Filters.

[9L]

Module-2

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Input and Output Characteristics of CB, CE and CC Configurations, dc and ac load line analysis, operating point, Transistor biasing: Fixed bias, emitter bias/self-bias, Low-frequency response of CE amplifier.

Field Effect Transistors: JFET, Idea of Channel Formation, Pinch-Off and saturation Voltage, Current-Voltage Output Characteristics; MOSFET: Basic structure, operation and characteristics.

[9L]

Module-3

Sinusoidal Oscillators: Concept of positive and negative feedback, Barkhausen criterion for sustained oscillations, Determination of Frequency and Condition of oscillation, Hartley and Colpitts oscillator.

Operational Amplifiers: Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Inverting and non-inverting amplifiers, Offset error voltages and currents; Power supply rejection ratio, Slew Rate and concept of Virtual Ground, Summing and Difference Amplifiers, Differentiator and Integrator, RC phase shift oscillator.

[9L]

Module-4

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators, Symbolic representation, Boolean algebraic function and Truth table of different Digital logic Gates (AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR); Realization of Basic logic gates using universal gates, Adder, Subtractor, adder/subtractor.

[9L]

Module-5

Electronic communication: Introduction to electronic communication system, Electromagnetic Communication spectrum band and applications, Elements of Electronic Communication System; Merits and demerits of analog and digital communication, Modes of communication; Signal radiation and propagation; Need for modulation; Introduction to Amplitude modulation and Angle modulation.

[9L]

Text Books:

1. Millman J., Halkias C.C., Parikh Chetan, Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Edition, Tata McGraw-Hill.
2. Mano M.M., Digital Logic and Computer Design, Pearson Education, Inc, Thirteenth Impression, 2011.
3. Singal T. L., Analog and Digital Communications, 2nd Edition, Tata McGraw-Hill.
4. Haykin S., Moher M., Introduction to Analog & Digital Communications, 2nd Edition, Wiley India Pvt. Ltd.

Reference Book:

1. Boylestad R.L., Nashelsky L., Electronic Devices and Circuit Theory, 10th Edition Pearson Education, Inc.

Gaps in the syllabus (to meet Industry/Profession requirements): Teaching through paper

POs met through Gaps in the Syllabus: P10 will be met through 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	Quizzes
CD3	Assignments/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 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
Quizzes	10+10
Assessment by teacher	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid SEM Examination Marks					
End SEM Examination Marks					
Quizzes					
Assessment by teacher					

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

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

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, CO2, CO3, CO4	CD1
CD2	Quizzes	CO1, CO2, CO3	CD2
CD3	Assignments/Seminars	CO3	CD3
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: EC 102

Course title: Electronics & Communication Lab

Pre-requisite(s):

Co- requisite(s):

Credits: L: 0 T: 0 P: 3 C: 1.5

Class schedule per week: 03

Class: B. Tech.

Semester / Level: I/First

Branch: ALL

Name of Teacher:

Course Objectives:

This course enables the students:

1.	To demonstrate the measurement of voltage, frequency using CRO.
2.	To explain PN junction characteristics and its applications.
3.	To understand the frequency response of BJT amplifier and OPAMP.
4.	To Realize logic gates and implement simple Boolean expression.
5.	To explain the Amplitude Modulation and Frequency Modulation

Course Outcomes:

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

CO1	Make use of CRO for measuring different parameters.
CO2	Appraise PN junction characteristics and its applications.
CO3	Experiment with Diodes, BJT and OPAMP.
CO4	Design specified circuit using given electronic components/ICs/logic gates.
CO5	Demonstrate the working of Amplitude Modulation and Frequency Modulation

Syllabus

List of Compulsory experiments:

1. Measurement of voltage, time period and frequency of different signals on CRO.
2. Measurement of frequency and phase of two different signals using Lissajous pattern.
3. To determine the forward and reverse bias characteristics of PN junction diode.
4. To determine the reverse bias characteristics of Zener diode and application as a voltage regulator.
5. Measurement of rectification efficiency and ripple factor of Half-wave and Full-wave rectifier Circuits with and without C-Filter.
6. To determine the frequency response of CE transistor amplifier and finding its gain bandwidth product.
7. To determine the transfer characteristics of JFET and measurement of its voltage gain.
8. Design of RC phase shift oscillator using IC-741 Op-Amp and finding its frequency of oscillation.

9. Design of Inverting and Non-inverting amplifier using IC 741 OP-AMP and finding its frequency response.
10. Realization of Basic logic gates (AND, OR, NOT) using NAND Gate (IC-7400).
11. Implementation of Boolean expression $F = (A.B.C + D.E)$ using AND Gate(IC 7408) and OR Gate (IC 7432).
12. Generation of Amplitude modulated wave and calculation of percentage of modulation using standard setup.
13. Generation of FM-wave and its detection using standard setup.

Text Books:

1. Millman J., Halkias C.C., Parikh Chetan, Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Edition, Tata McGraw-Hill.
2. Mano M.M., Digital Logic and Computer Design, Pearson Education, Inc, Thirteenth Impression, 2011.
3. Singal T. L., Analog and Digital Communications, 2nd Edition, Tata McGraw-Hill.
4. Haykin S., Moher M., Introduction to Analog & Digital Communications, 2nd Edition, Wiley India Pvt. Ltd..

Reference Book:

1. Boylestad R.L., Nashelsky L., Electronic Devices and Circuit Theory, 10th Edition Pearson Education, Inc.

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:

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

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 Viva marks	24
Lab file Marks	12
Day-to-day performance Marks	12
End SEM Evaluation	(40)
Lab quiz Marks	20
Lab performance Marks	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive Evaluation					
End SEM Evaluation					

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

Course Outcome #	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	1	2	1	1	1				3	
CO2	3	2	1	2	2	1	1				1	
CO3	3	2	1	2	2	1	2		1	1	1	1
CO4	3	3	1	2	3	1	2		1	1	3	1
CO5	3	2	1	2	1	1	1				3	

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		
CD2	Tutorials/Assignments/Quiz (s)		
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids	CO1, CO2, CO3, CO4	CD5
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation	CO1, CO2, CO3, CO4	CD9



**BIRLA INSTITUTE OF TECHNOLOGY
MESRA**

RANCHI, INDIA

CHOICE BASED CURRICULUM

Under Graduate Programme

Department of Mechanical Engineering

Program Outcomes

A graduate shall

1. Be competent in applying basic knowledge of science and engineering for the purpose of obtaining solution to a multi-disciplinary problem.
2. Gain skilful knowledge of complex engineering problem analysis.
3. Be able to design system components and processes meeting all applicable rules and regulations.
4. Be proficient in arriving at innovative solution to a problem with due considerations to society and environment.
5. 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.
6. Continually upgrade his/her understanding and become masterly at modern engineering and soft tools and apply them along with other appropriate techniques and resources.
7. 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.
8. Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
9. 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.
10. 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.
11. 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.
12. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

Course code: ME 101

Course title: Basics of Mechanical Engineering

Pre-requisite(s):

Co- requisite(s):

Credits: 4 L: 3, T: 1, P: 0

Class schedule per week: 04

Class: B. Tech

Semester / Level: I/First

Branch: All

Name of Teacher:

Course Objectives

This course enables the students:

1.	To introduce system of forces, and write equation of equilibrium.
2.	To analyse motion of particle and rigid body subjected to force.
3.	To grasp the importance of internal, external combustion engines and heat transfer.
4.	To apprehend the fundamentals of friction and vibration.
5.	To understand the different sources of energy.

Course Outcomes

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

CO1	Write and solve the equations of equilibrium for particles and structures members subjected to forces.
CO2	Write and solve the equations of motion for particles and rigid bodies subjected to forces.
CO3	Discuss the basics of Boilers, IC Engines and heat transfer.
CO4	Aware of different types of vibrations and friction.
CO5	Outline the non-conventional energy resources.

(ME 101) Basics of Mechanical Engineering

Syllabus

Module 1: System of Forces and Structure Mechanics

Addition of Forces, Moment of a Force, Couple, Varignon's theorem, Free Body Diagram, Equilibrium in Two and Three Dimensions, Equivalent Forces and Moment. Types of Trusses, Plane and Space Trusses. Analysis of Plane Trusses by: Method of Joints and Method of Sections, Analysis of Frames with Hinged Joints. Hooke's Law of elasticity, Stress and Strain, Relation between elastic constants, Thermal Stresses, Properties of surfaces such as centroid and area moment of inertia. (9 L)

Module 2: Kinematics & Kinetics of rigid bodies

Types of rigid body motion – translation, rotation about fixed axis, equations defining the rotation of a rigid body about a fixed axis, plane motion, absolute and relative velocity in plane motion, instantaneous center of rotation. Equation of translational and rotational motion, Newton's law and D'Alembert's principle – inertia force and inertia couple. (9 L)

Module 3: Friction and Vibration

Interfacial Friction (a) Laws of dry friction, static & kinetic co-efficient of friction, Analysis of static, kinetic and rolling friction.(b) Analysis of frictional forces in inclined planes, wedges, screw jacks and belt drives.

Vibrations: Types of vibration, free un-damped longitudinal vibrations, free damped longitudinal vibrations. (9 L)

Module 4: Boilers and Internal Combustion Engine:

Boiler Mountings and Accessories, Fire Tube and Water Tube Boilers, Cochran Boiler, Babcock and Wilcox Boiler.

Basic components and terminology of IC engines, working of four stroke/two stroke - petrol/diesel engine, classification and application of IC engines.

Heat transfer: various modes of heat transfer, one dimensional steady state conduction, Application to composite walls and cylinder. (9 L)

Module 5: Non-Conventional Energy and their resources:

Renewable and Non-renewable Energy Resources, Advantages and Disadvantages of Renewable Resources, Renewable Energy Forms and Conversion, Solar Energy, Wind Energy, Tidal Energy, Ocean Thermal Energy; Geothermal Energy, Nuclear Energy, Hydro Energy. (9 L)

Text Books

1. Engineering Mechanics, Irving H. Shames, P H I. ltd, 2011.
2. Engineering Mechanics, S. Timoshenko, D. H. Young, J. V. Rao, Sukumar Pati, McGraw Hill education, 2017.
3. Theory of vibrations with applications, Thomson and Dahleh, Pearson Education, 5th Edition, 2008.
4. Boiler operator, Wayne Smith, LSA Publishers, 2013.
5. Internal Combustion Engines, M. L. Sharma and R. P. Mathur, Dhanpat Rai Publications, 2014.
6. Heat Transfer, J. P. Holman, Souvik Bhattacharya, Mcgraw Higher Ed Publishers, 2011.
7. Fundamentals of Renewable Energy Processes, Aldo Vieira Da Rosa, Elsevier publication, 2012.

Reference Books

1. Engineering Mechanics : statics, James L. Meriam, L. G. Kraige, Wiley, 7th Edition, 2011.
2. Engineering Mechanics, S. Rajasekaran & G. Sankarasubramaniam, Vikash publishing house, 2018.
3. Engineering Vibration, Daniel J. Inman, Pearson, 2013.
4. An Introduction to Steam Boilers, David Allan Low, Copper Press Publisher, 2012.
5. Internal Combustion Engines ó V Ganesan, McGraw hill, 2017.
6. Heat and Mass Transfer: Fundamentals and Applications, Yunus A. Cengel, Afshin J. Ghajar, McGraw Hill Education Publisher, 2017.
7. Non Conventional Energy Resources, B. H. Khan, McGraw Hill Education Publisher, 2017.
8. Principles of Mechanical Engineering, R. P. Sharma & Chilkesh Ranjan, Global Academic Publishers, 2016.

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
Quizzes (1 and 2)	10+10
Assignment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Mid Sem Examination Marks	√	√	√		
End Sem Examination Marks	√	√	√	√	√
Quizzes	√	√	√	√	√
Assignment	√	√	√	√	√

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

Indirect Assessment –

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

COURSE INFORMATION SHEET

Course code: ME 102

Course title: Engineering Graphics Lab

Credits: 2.0 L: 0, T:0, P:4

Class schedule per week: 04

Class: B. Tech

Semester / Level: I / First

Branch: All

Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand the basic principles of Engineering Graphics, which include projections of 1D, 2D and 3D objects.
2.	To visualize a solid object (including sectioned) and convert it into drawing.
3.	To visualize different views of any object.
4.	To develop skill to draw objects using software.
5.	To inculcate the imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.

Course Outcomes

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

CO1	Understand the fundamentals of Engineering Graphics and sketch the orthographic projections of points, lines and planes.
CO2	Sketch the orthographic projections of solids and section of solids.
CO3	Sketch three dimensional isometric views and development of the surfaces.
CO4	Create and modify orthographic projections using AutoCAD software.
CO5	Create three dimensional solid models using AutoCAD software.

(ME 102) Engineering Graphics Lab

Syllabus

Module 1: Introduction to orthographic projections, Conventions, Fundamentals of First and Third Angle projection, Orthographic projections of points, lines and planes.

(9L)

Module 2: Projections of simple solids - axis perpendicular to HP, VP and inclined to one or both planes, Sectioning of solids, section plane perpendicular to one plane and parallel or inclined to other plane.

(9L)

Module 3: Development of surfaces- Development of prisms, pyramids and cylindrical & conical surfaces, Isometric projection and isometric views of different planes and simple solids, introduction to perspective projection.

(9L)

Module 4: Working with AutoCAD Commands, Cartesian Workspace, Basic Drawing & Editing Commands, Drawing: Lines, Rectangles, Circles, Arcs, Polylines, Polygons, Ellipses, Creating Fillets and Chamfers, Creating Arrays of Objects, Working with Annotations, Adding Text to a Drawing, Hatching, Adding Dimensions, Dimensioning Concepts, Adding Linear Dimensions, Adding Radial & Angular Dimensions, Editing Dimensions.

(9L)

Module 5: Create views of engineering parts in AutoCAD, case studies with examples of Mechanical/ Electrical/Civil engineering drawings.

(9L)

Text Books

1. Engineering Drawing by N. D. Bhatt, Charotar Publishing House Pvt.Ltd., 53rd Edition, 2014.
2. Engineering Drawing and Graphics + AutoCAD by K. Venugopal, New Age International (P) Limited, 4th Reprint: June, 2017.

Reference Books

1. Engineering Graphics with Autocad by J. D. Bethune, Prentice Hall, 2007.

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Progressive evaluation	60
End Semester Lab Examination Marks	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Progressive evaluation Marks	√	√	√	√	√
End Semester Lab Examination Marks	√	√	√	√	√

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											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	2	3	1			3	3	3		
CO2	3	3	2	3	1			3	3	3		
CO3	3	3	2	3	1			3	3	3		
CO4	3	3	2	3	3			3	3	3		
CO5	3	3	2	3	3			3	3	3		



**BIRLA INSTITUTE OF TECHNOLOGY
MESRA**

RANCHI, INDIA

CHOICE BASED CURRICULUM

Under Graduate Programme

Department of Physics

Program Outcomes

1. Demonstrate knowledge on fundamental principles and concepts, apart from the knowledge on various systems, standards and their applications related to physics.
2. Have ability for in depth analytical and critical thinking in order to conceptualize, analyse, design and improve different kinds of electronic systems and communication applications reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. Have ability to design system components and processes meeting all applicable consideration for public health and safety, cultural, societal and environmental considerations.
4. Have ability to investigate and analyse complex problems and development of appropriate solution.
5. Have ability to use lab equipment using modern tools and relevant simulation software to perform measurements, experiments, design and analysis.
6. Be able to apply reasoning informed contextual knowledge to assess societal, health, safety legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
7. Exhibit understanding of societal and environmental issues (health, legal, safety, cultural etc.) relevant to professional engineering practice and demonstrate knowledge of and the need for sustainable development.
8. Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
9. Have ability to work as an individual, in a team or team leader, in a multidisciplinary team.
10. Have ability in written and oral communications to effectively communicate product design and analysis.
11. Develop know-how in project management and finance to acquire leadership position in industry.
12. Have and interest and aptitude for life-long learning and continuous professional development.

COURSE INFORMATION SHEET

Course code: PH 113

Course title: PHYSICS

Pre-requisite(s): Intermediate Physics and Intermediate Mathematics

Co- requisite(s):

Credits: 4 L:3 T:1 P:0

Class schedule per week: 3+1

Class: B. Tech

Semester / Level: I/First

Branch: ALL

Name of Teacher:

Course Objectives

This course enables the students:

1	To explain principles of physical optics.
2	To construct Maxwell's equations from basic principles and use it to solve electromagnetic plane wave equations.
3	To distinguish between Newtonian Mechanics and special theory of relativity and develop the relationship of length contraction, time dilation and Einstein energy mass relation and to apply the concepts of special theory of relativity in various field of physics and engineering.
4	To illustrate the phenomena of old quantum theory and derive Heisenberg uncertainty principle and Schrödinger's equations.
5	To understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.

Course Outcomes

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

CO1	To interpret the intensity variation of light due to Polarization, interference and diffraction.
CO2	To formulate and solve the engineering problems on electromagnetism.
CO3	To explain special theory of relativity and apply its concepts in various fields of physics and engineering.
CO4	To explain fundamentals of quantum mechanics and apply it to problems on bound states.
CO5	To analyze working principle of lasers and to summarize its applications.

(PH 113) PHYSICS

Module-1	Physical Optics: Polarization, Malus's Law, Brewster's Law, Double Refraction, Interference in thin films (Parallel films), Interference in wedge-shaped layers, Newton's rings, Fraunhofer diffraction by single slit, Double slit.	[9L]
Module-2	Electromagnetic Theory: Curl, Gradient, Divergence, Gauss theorem, Stokes theorem, Gauss's law, Applications, Concept of electric potential, Relationship between E and V, Polarization of dielectrics, dielectric constant, Boundary conditions for E & D, Gauss's law in magnetostatics, Ampere's circuital law, Boundary conditions for B & H, Equation of continuity of charge, Displacement current, Maxwell's equations.	[9L]
Module-3	Special Theory of Relativity: Introduction, Inertial frame of reference, Galilean transformations, Postulates, Lorentz transformations and its conclusions, Length contraction, time dilation, velocity addition, Mass change, Einstein's mass energy relation.	[9L]
Module-4	Quantum Mechanics: Planck's theory of black-body radiation, Compton effect, Wave particle duality, De Broglie waves, Davisson and Germer's experiment, Uncertainty principle, physical interpretation of wave function, Schrodinger equation in one dimension, free particle, particle in an infinite square well.	[9L]
Module-5	Lasers: Spontaneous and stimulated emission, Einstein's A and B coefficients, Population-inversion, Light amplification, Basic laser action, Ruby and He-Ne lasers, Properties and applications of laser radiation, Elementary ideas of fiber optics and application of fiber optic cables.	[9L]

Text books:

T1: A. Ghatak, Optics, 4th Edition, Tata Mcgraw Hill, 2009

T2: Mathew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2001

T3: Arthur Beiser, Concept of Modern Physics, 6th edition, Tata McGraw- Hill, 2009

Reference books:

R1: Fundamentals of Physics, Halliday, Walker and Resnick

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

POs met through Gaps in the Syllabus : NA

Topics beyond syllabus/Advanced topics/Design : NA

POs met through Topics beyond syllabus/Advanced topics/Design

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

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	10+10
Teacher's assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
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 of Course Outcomes onto Graduate Attributes

Course Outcome #	Graduate Attributes											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2		3	3	3		3	2	2		3
2	3	3		3	3	3		3	2	2		3
3	3	1		2	1	2		3	2	2		3
4	3			3	2	2		2	2	2		3
5	2	3		3	3	3	3	2	2	2		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	CD1 and CD2
CD2	Tutorials/Assignments	CO2	CD1 and CD2
CD3	Seminars	CO3	CD1 and CD2
CD4	Mini projects/Projects	CO4	CD1 and CD2
CD5	Laboratory experiments/teaching aids	CO5	CD1 and 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 INFORMATION SHEET

Course code: PH 114

Course title: PHYSICS LAB

Pre-requisite(s): Intermediate Physics (Theory and Lab)

Co-requisite(s):

Credits: 1.5 L:0 T:0 P:3

Class schedule per week: 3

Class: B. Tech

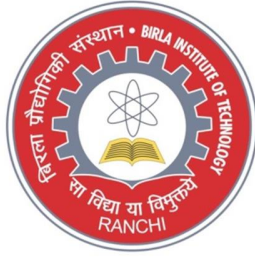
Semester / Level: I/ First

Branch: ALL

Name of Teacher:

List of Experiments

1. Error analysis in Physics Laboratory
2. To determine the frequency of AC mains with the help of sonometer
3. To determine the wavelength of sodium light by Newton's rings Method
4. To determine the resistance per unit length of a Carey Foster's bridge wire and then to find the resistivity of the material of a given wire.
5. Measurement of mechanical equivalent of heat by electrical method
6. Determination of refractive index of the material of a prism using spectrometer and sodium light
7. To determine the frequency of electrically maintained tuning fork by Melde's experiment
8. Measurement of voltage and frequency of a given signal using cathode ray oscilloscope
9. To determine the wavelength of prominent spectral lines of mercury light by a plane transmission grating using normal incidence
10. To determine the electromotive force (emf) of an unknown cell using a stretched wire potentiometer
11. To study the frequency response and quality factor of series LCR circuit.
12. To find the specific rotation of sugar solution by using a polarimeter.
13. To determine the Hall voltage and calculate the Hall coefficient and carrier concentration of a semiconductor sample



**BIRLA INSTITUTE OF TECHNOLOGY
MESRA
RANCHI, INDIA**

CHOICE BASED CURRICULUM

Under Graduate Programme

Department of Computer Science & Engineering

Program Outcomes (PO)

1. A graduate will demonstrate a fundamental understanding of the basic sciences, mathematics and engineering concepts by applying them to engineering problems of varying degrees of complexity.
2. A graduate will be competent in applying systematic rigor to understanding a engineering problem, exploring its background, investigating possible solution methodologies and comparing their merits and demerits.
3. A graduate shall be equipped in designing efficient solutions for complex engineering problems, while complying with all established social, medical, environmental norms.
4. A graduate shall perform high quality simulations and experiments for problems of varying degrees of complexity, interpret the outputs and infer correct results and trends from the experiments.
5. A graduate shall be adept at the use of the appropriate IT tools to rapidly prototype and deploy efficient solutions to real life problems. In doing so he should demonstrate sufficient knowledge of competing tools and their relative merits and demerits.
6. A graduate shall be sensitive to social, legal and ethical concerns and tune his knowledge to be a responsible engineer adhering to all established practices of his profession. She/he will display special concern for devising environment friendly solutions that shall make a positive impact on society.
7. A graduate will be trained as a team player, well versed in understanding the dynamics of working in a team, in leading when necessary and comfortable working across the globe.
8. A graduate will be articulate in his presentation, oral, written and graphical. He will convey his designs in unambiguous and clear terminology, use accepted documentation tools and provide instructions which are easily interpretable.
9. A graduate shall determine the financial aspects of a project with sufficient reliability, make effective cost estimates and convey achievable timelines for his/ her projects.
10. A graduate will demonstrate the traits of learning and unlearning throughout his professional career, and be willing to learn new techniques, methods and processes.
11. Will constantly endeavour to know about and keep pace with the advancement in software industry, so as to be able to contribute affectively to the organization.
12. Graduates shall strive to adept a research attitude towards all his/her assignment whether in academics, higher studies or industries.

COURSE INFORMATION SHEET

Course code: CS 101

Course title: Programming for Problem Solving

Pre-requisite(s):

Co-requisite(s): Programming for Problem Solving Lab

Credits: L: 3 T: 1 P: 0

Class schedule per week: 4

Class: B.Tech

Semester / Level: I / First

Branch: All

Course Objectives

This course enables the students:

1.	To learn computer language.
2.	To learn coding for solving scientific and engineering problems.
3.	To learn the problem-solving process through computer.
4.	To know the limitations of system during program execution.
5.	To know the practical application of various programming techniques.

Course Outcomes

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

CO1	To formulate simple algorithms for arithmetic and logical problems.
CO2	To translate the computer algorithms to computer programs.
CO3	To test and execute the programs and correct syntax and logical errors.
CO4	To apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

(CS 101) Programming for Problem Solving

Syllabus

Module I [9L]

Introduction to Programming:

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Problem Solving: Steps to solve logical and numerical problems.

Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

Module II [9L]

Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals, Iterations, Loops.

Module III [9L]

Array, Character array, strings. Case studies to discuss the various Problems related to Basic science (Matrix addition, Matrix-matrix multiplication, Roots of an equation etc.), Sorting, Searching.

Module IV [9L]

Functions (including using built in libraries), Parameter passing in functions, call by value, call by reference. Passing arrays to functions, Recursion (Finding Factorial, Fibonacci series, Ackerman function etc.).

Module V [9L]

Structures, Defining structures and Array of Structures

Pointers: Defining pointers, Use of Pointers in self-referential structures, File Handling

Text Books:

1. Jerry R Hanly, Problem solving and Program design in C, 7th Edition, Pearson Education.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. ReemaThareja, Introduction to C Programming, 2nd Edition, Oxford University Press, 2015.
4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice.
5. Byron Gottfried, Schaum's Outline of Programming with C, Tata McGraw-Hill.

Mapping of Course Outcome with Program Outcomes

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

COURSE INFORMATION SHEET

Course code: CS 102

Course title: Programming for Problem Solving Lab

Pre-requisite(s):

Co- requisite(s): Programming for Problem Solving

Credits: L: 0 T: 0 P: 3

Class schedule per week: 1

Class: B. Tech

Semester / Level: I / First

Branch: All

Course Objectives

This course enables the students:

1.	To learn computer language.
2.	To learn coding for solving scientific and engineering problems.
3.	To learn the problem-solving process through computer.
4.	To know the limitations of system during program execution.
5.	To know the practical application of various programming techniques.

Course Outcomes

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

CO1	To formulate simple algorithms for arithmetic and logical problems.
CO2	To translate the computer algorithms to computer programs.
CO3	To test and execute the programs and correct syntax and logical errors.
CO4	To apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

Sample Program List

Module 1 & Module 2: Introduction and Control Flow

1. Write an interactive program that will read in a +ve integer value and determine the following
 - i) If the integer is a prime number
 - ii) If the integer is a Fibonacci number
2. WAP in C to compute $\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$ to five place of accuracy. Test the program for $x = 1$, $x = 2$, and $x = 3$. In each case display the number of terms used to obtain the final answer.
3. WAP to generate every 3rd integer beginning with $I = 2$ and continue for all integers that are less than 150. Calculate the sum of those integers that are evenly divisible by 5.
4. WAP to find whether a given year is a leap year or not. Modify it to generate a list of leap years between two year limits given by user.
5. WAP to display the following pattern :

```
                11
              11  10  11
            11  10  9  10  11
          11  10  9  8  9  10  11
```
6. Using Ternary / Conditional operator find the greatest among 3 numbers.
7. WAP to convert a decimal number into an equivalent number of the input base. Test your program for base 2, 8 & 16.
8. WAP to read a number n, and print it out digit-by-digit, as a series of words. For e.g. 123 would be printed as "one two three".
9. WAP to check whether any input +ve integer is palindrome or not.
10. WAP to simulate a simple calculator (+ - / * %) that takes two operands and an operator as input and displays the result.
11. WAP to find the GCD of two input +ve integer numbers. Using this find GCD of 9 numbers.
12. WAP to swap the values of two variables without using a third variable.

Module 3: Array

13. Read a line of mixed text, and then write it out with all lower case and uppercase letters reversed, all digits replaced by 0s and all other characters (non-letters and non-digits) replaced by \backslash .
14. WAP to find the product of two matrices A and B. Display the source matrices and product matrix C in matrix format.
15. WAP to find whether a given matrix is a triangular matrix or not.
16. WAP to find the transpose of a matrix. Display the source and the transposed matrix in matrix format.
17. Implement Prob. No. 14 to 16 using functions for reading, manipulating and displaying the corresponding matrices in matrix form.
18. WAP to sort a list of strings alphabetically using a 2-dim. Character array.
19. WAP to display the row sum and the column sum of an input 2- dim. Matrix. Display the source matrix with row and column sum.

Module 4: Functions, Pointer & String

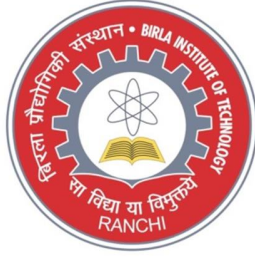
20. Write a recursive function to calculate $S = 2 + 4 + 6 + 8 + \dots + 2N$. Implement the function in a complete C program.
21. Write a function that accepts two arguments an array and its size n. It performs Bubble up sort on the array elements. Using indirection operator `*` implement this in a complete C program. Display the source and the sorted array.
22. Using pointer, write a function that receives a character string and a character as argument. Delete all occurrences of this character in the string. The function should return corrected string with no holes.
23. Write a function for reading character string using pointer. Calculate the length of the string (without using `strlen()`). Finally print the string in reverse order, using pointer.
24. Implement prob. No. 14 using pointers representation of 2 dim. array.
25. Implement prob. No. 15 using pointer representation of 2 dim. array.
26. Implement prob. No. 16 using pointer representation of 2 dim. array.
27. WAP to sort a list of strings into alphabetical order using array of pointers.

Module 5: Structure and File

28. Create records of 60 students, where each record has fields-name, roll, GPA and fees. Write a function `update()` to reduce the fees of those students who have obtained GPA greater than 8.5 by 25% of the original fees. Write a complete program to exercise this function in the main program and display all the records before and after updation.
29. Define a structure that describes a hotel. It should have members that include the name, address, grade, average room charge and number of rooms. Write a function to perform the following operations:
 - a) To print out hotels of a given grade in order of charges.
 - b) To print out hotels with room charges less than a given value.
30. WAP to concatenate the contents of two files into a third file.
31. WAP to copy the content of one file into another file. Names of both the files are to be input as command line arguments

Mapping of Course Outcome with Program Outcomes

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



**BIRLA INSTITUTE OF TECHNOLOGY
MESRA
RANCHI, INDIA**

CHOICE BASED CURRICULUM

Under Graduate Programme

Department of Electrical and Electronics Engineering

Program Outcomes (PO)

A graduate shall

1. Be competent in applying basic knowledge of science and engineering for the purpose of obtaining solution to a multi-disciplinary problem.
2. Gain skilful knowledge of complex engineering problem analysis.
3. Be able to design system components and processes meeting all applicable rules and regulations.
4. Be proficient in arriving at innovative solution to a problem with due considerations to society and environment.
5. 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.
6. Continually upgrade his/her understanding and become masterly at modern engineering and soft tools and apply them along with other appropriate techniques and resources.
7. 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.
8. Be committed to professional ethics, responsibilities and economic, environmental, societal, and political norms.
9. 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.
10. 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.
11. 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.
12. Recognize the need for continuous learning and will prepare himself/ herself appropriately for his/her all-round development throughout the professional career.

COURSE INFORMATION SHEET

Course code: EE 101

Course title: BASICS OF ELECTRICAL ENGINEERING

Pre-requisite(s): Basic Sciences

Co- requisite(s):

Credits: L: 3 T: 1 P: 0

Class schedule per week: 04

Class: B. Tech.

Semester / Level: I / FIRST

Branch: ALL

Name of Teacher:

Course Objectives

This course envisions to impart to students to:

1.	Classify different electrical circuit elements and apply suitable laws and theorems for the analysis of electrical systems.
2.	Represent series / parallel electric / magnetic circuits.
3.	Employ three phase circuits for transfer of electrical power both under balanced and unbalanced condition.
4.	Interpret the system responses under different operating conditions such as resonance, mutual coupling and star-delta conversion.
5.	Assess the working of different A.C. electrical machines.

Course Outcomes

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

CO1	Solve electrical circuits using Kirchhoff's laws and apply concepts of magnetic circuits in electrical systems.
CO2	Analyze A.C. electrical circuits having dependent and independent sources for computation of responses such as voltage, current, power.
CO3	Evaluate the advantages of 3 phase system in electrical industrial applications and differentiate between balanced and unbalanced operation.
CO4	Assess the applicability of circuit theorems for practical applications.
CO5	Integrate the sources of energy for transferring power to the consumers (load).

(EE 101) Basics of Electrical Engineering

Syllabus

Module 1

Introduction: Importance of Electrical Engineering in day-to-day life, Electrical elements, properties and their classification, Ideal and Real Sources, Source Conversion.

D.C. Circuits: KCL and KVL, Loop current and Nodal voltage method Steady state analysis with independent and dependent sources, Star-Delta conversion.

Magnetic Circuits: Introduction, Series-parallel magnetic circuits, Analysis of Linear and Non-linear magnetic circuits, Energy storage, A.C. excitation, Eddy currents and Hysteresis losses.

(9L)

Module 2

Single-phase AC Circuits: Series Circuits: Common signals and their waveforms, RMS and Average value, Form factor & Peak factor of sinusoidal waveform, Impedance of Series circuits.

Phasor diagram, Active Power, Power factor. Power triangle.

Parallel Circuits: Admittance method, Phasor diagram. Power, Power factor. Power triangle, Series- parallel Circuit, Power factor improvement,

Series and Parallel Resonance: Resonance curve, Qófactor, Dynamic Impedance and Bandwidth.

(9L)

Module 3

Three-Phase Circuits: Line and Phase relation for Star and Delta connection, Power relations, Analysis of balanced and unbalanced 3 phase circuits, Measurement of Power.

(9L)

Module 4

Circuit Theorems: Superposition theorem, Thevenin's & Norton's Theorem, Maximum Power Transfer theorem for Independent and Dependent Sources for DC and AC circuits.

Coupled Circuits (Dot rule), Self and mutual inductances, Coefficient of coupling.

(9L)

Module 5

Working principles of AC Generators, motors and transformers, working principles of measuring equipments such as digital voltmeter, ammeter, power factor meter and wattmeter.

(9L)

Text books:

1. Hughes, Electrical Technology, Pearson, 10th Edition, 2011.
2. Fitzgerald and Higginbotham, Basic Electrical Engineering, McGraw Hill Inc, 1981.
3. D.P. Kothari and I.J. Nagrath, Basic Electrical Engineering, 3rd Edition, TMH, 2009.

Reference books:

1. W. H. Hayt, Jr J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 7th Edn TMH, 2010.
2. Electrical Engineering Fundamental, Vincent Del Toro, Prentice Hall, New Delhi.

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. Field applications of three phase equipment and circuits in power system.
3. Applications of circuit theorems in electrical and electronics engineering.

POs met through Gaps in the Syllabus

3, 4, 12

Topics beyond syllabus/Advanced topics/Design

1. Concepts of electric, magnetic and electromagnetic fields
2. 3 - power generation and transmission
3. Power factor improvement for three phase systems
4. Utility of reactive power for creation of electric and magnetic fields

POs met through Topics beyond syllabus/Advanced topics/Design

2, 3, 4, 12

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											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	3	1	3	1	1	1				2
CO2	3	3	3	1	3	1	1	1				2
CO3	3	3	3	3	3	1	2	2		1	1	2
CO4	3	3	3	1	3		1	1		1	1	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2

3= High, 2=Medium, 1=Low

COURSE INFORMATION SHEET

Course code: EE102

Course title: Electrical Engineering Laboratory

Pre-requisite(s): Physics, Fundamentals of Mathematics and Electrical Engineering.

Credits: L:0 T:0 P: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:

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

Course Outcomes

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

CO1	classify active and passive elements, explain working and use of electrical components, different types of measuring instruments;
CO2	illustrate fundamentals of operation of DC circuits, 1- and 3- circuits and also correlate the principles of DC, AC 1- and 3- circuits to rotating machines like Induction motor and D.C machine.;
CO3	measure voltage, current, power, for DC and AC circuits and also represent them in phasor notations;
CO4	analyse response of a circuit and calculate unknown circuit parameters;
CO5	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: 1, 2, 3, 7.**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: 5, 6, 7, 8, 9.**Mapping of lab experiment with Course Outcomes**

Experiment	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
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	

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 Evaluation:

Daily individual assessment through viva:	20	} Progressive evaluation (60)
Regular evaluation of fair and rough copy:	15+5=20	
Regularity/Punctuality:	10	
Assignment:	10	
Practical examinations:	20	} end evaluation (40)
End sem Viva-voce :	20	

TOTAL: 100
Mapping of Course Outcomes onto Course Objectives

Course Outcome #	Course Objectives			
	CO1	CO2	CO3	CO4
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											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	3	3	L	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	H	H	M	M

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 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
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		



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

MA 203

Syllabus
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, composting, 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 Saunders 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 devices and 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 engineering arguments.
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 performance of 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, manometric 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. Cengel 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-Fr1A>

<http://engineeringvidelectures.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 differential 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 bodies viz. 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 beam and thin circular ring. (10 Lectures)

Module: 4

Shear Centre: Theory of shear flow, shear flow diagrams and shear center for thin walled symmetrical sections.
Bending of curved beams: Beams of small and large initial curvature, evaluation of circumferential 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, 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 $-3 \leq y \leq 3$.

Sample Assignments on MATLAB

Assignment Statements:

1. Given two sides $a= 3.2$ and $b=4.6$ of a triangle and angle $\theta= 60^\circ$ 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, $A = \begin{bmatrix} 12356791011 & 4812 \end{bmatrix}$. 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 the 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 function 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

Course Outcome #	Program Outcomes											
	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.	cepts 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 10×10 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 15×15 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 10×10 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

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

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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: 1.5L: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 Bernoulli's 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 effect of 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 indeterminate 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

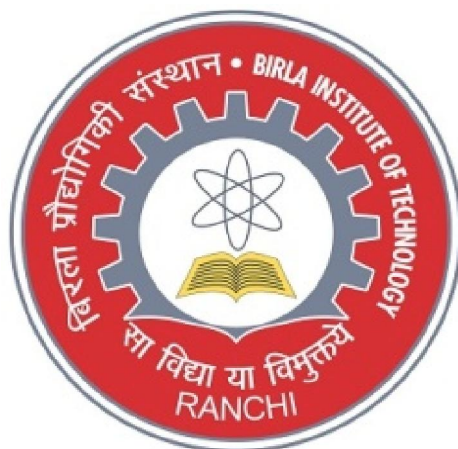
Group 5

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 interdisciplinary 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:

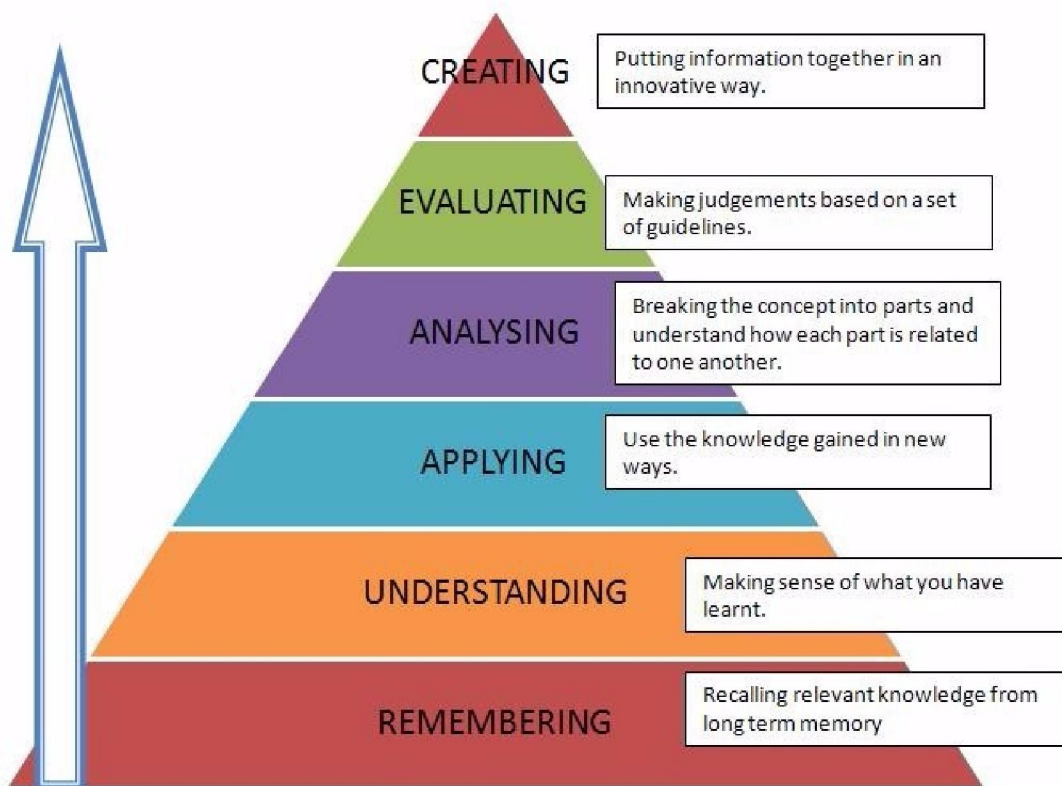
1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching 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.

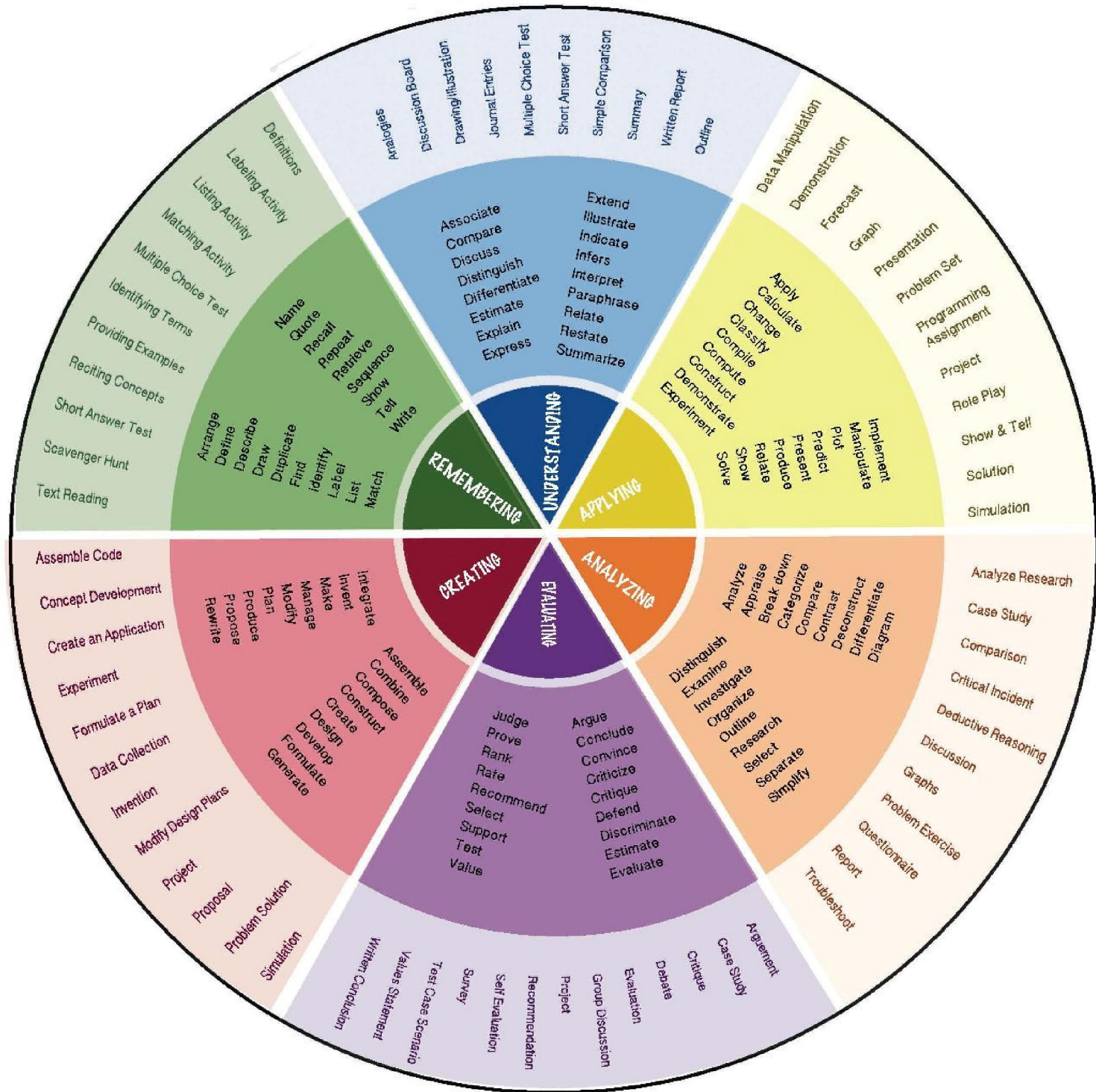
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being 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.





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-Culloch 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)

Module V

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. Madiseti Vijay and Bahga Arshdeep, 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 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 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 Balancing: Balancing of rotating masses, Two plane balancing, Balancing of inline, V, twin, and radial engines, principles of balancing machines.	8
Module – IV 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 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. Pennock and Joseph E. Shigley Theory 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)
<p>Module – I</p> <p><i>Vapour Power Cycle:</i> 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.</p>	<p>10</p>
<p>Module – II</p> <p><i>Fuels and Combustions:</i> Classification of fuels; basic chemistry and combustion equations; conversion of volumetric to weight analysis and vice-versa; theoretical and excess air; <i>Boiler performance:</i> Equivalent evaporation; Boiler efficiency; Heat balance; Boiler Draught; its classification; Chimney height, maximum discharge and efficiency.</p>	<p>10</p>
<p>Module – III</p> <p><i>Steam Nozzles:</i> 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.</p>	<p>7</p>
<p>Module – IV</p> <p><i>Steam Turbines:</i> 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.</p>	<p>10</p>
<p>Module – V</p> <p><i>Steam condensers:</i> 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.</p>	<p>5</p>

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)
<p>Module – I</p> <p>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.</p>	<p>10</p>
<p>Module – II</p> <p>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.</p>	<p>9</p>
<p>Module – III</p> <p>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.</p>	<p>9</p>
<p>Module – IV</p> <p>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.</p>	<p>9</p>
<p>Module – V</p> <p>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.</p>	<p>9</p>

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	Apply the underlying concepts on various thermo-fluid systems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I 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 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 Navier-Stokes equation and its applications; energy equation and its applications to various problems.	9
Module – IV 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 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. Munson and 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 of Fluids*, 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 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 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 Fiber Polymeric 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 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 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 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)
<p>Module – I 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.</p>	8
<p>Module – II 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.</p>	9
<p>Module – III 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</p>	9
<p>Module – IV 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.</p>	9
<p>Module – V OTHER RENEWABLE ENERGY SOURCES 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.</p>	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 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 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 Magnetic Particle Testing :Basic definition of Magnetism & Principle of MPT, Magnetizing Techniques, Procedure & Equipment used for MPT, Applications & limitations of MPT.	9
Module – IV 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 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.	<ol style="list-style-type: none"> 1. To conclude performance of 1 – Φ AC series circuits by resonance phenomena 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

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 Components	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 Governor

Objective: To determine the position of sleeve against controlling force and speed of a Hartnell governor 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 Promoters Pvt Ltd. **(T1)**
2. B S Raghuwanshi, "A course in Workshop Technology", Dhanpat Rai Publications. **(T2)**

REFERENCE 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

FIFTH SEMESTER

COURSE INFORMATION SHEET

Course Code: ME 123
Course Title: Thermo-Fluid Engineering
Credits: 3 (L: 3,T: 0,P: 0)
Class schedule per week: 3
Class: B. Tech.
Semester / Level: 5
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I Introduction to Business Communication: Importance and Objectives of Business communication, Process of communication, Barriers to effective communication, Techniques of effective communication. Forms of communication (Written, Oral, audio-visual communication).	8
Module –II Managing Business Communication Formal and Informal communication, Non- verbal communication (Body language, Gestures, Postures, Facial expressions). The cross-cultural dimensions of business communication. Techniques to effective listening, methods and styles of reading.	8
Module – III Other Aspects of Communication Vocabulary: Single word substitution, Idioms and phrases, Precis writing, Comprehension. Group Discussions, Extempore, Principles of effective speech and presentations, Role playing.	8
Module - IV Business letters: Inquiries, Circulars, Quotations, Orders, Acknowledgement, Claims & adjustments, Collection letters, Sales letters, Drafting of different resumes, Covering letters Applying for a job, Social correspondence, Invitation to speak. Official Correspondence: Memorandum, Notice, Agenda, Minutes, Circular letters.	8
Module –V Report writing Business reports, Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, check lists for reports.	8

Books recommended:

1. Communication Skills, Sanjay Kumar & PushpLata, Oxford University Press
2. Business Correspondence and Report Writing, R.C.Sharma, Krishna Mohan. Mcgraw Hill

3. Communication for Business, Shirley Taylor, V.Chandra, Pearson
4. Business Communication- HorySankar Mukherjee, Oxford University Press
5. Basic Business Communication-. Lesikar I Flatley, McGraw Hill.
6. Business Communication Today, Bovee, Thill and Chaterjee, Pearson.

COURSE INFORMATION SHEET

Course code:	ME 301
Course title:	IC Engine and Gas Turbine
Credits:	3 (L:3, T:0, P:0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	5
Branch:	Mechanical Engineering

Syllabus

Module	Hours
Module: 1 Introduction to I.C. Engine, SI and CI Engine, Air standard Otto and Diesel cycles, valve timing diagrams, Fuel-air Cycles and actual air cycle and their analysis.	10
Module –II Combustion in SI Engines: Combustion in S.I. engines, stages, ignition lag, factors affecting ignition lag, flame propagation and its factors, knocking and its factors, control of knock. Combustion in C.I. engines, stages of combustion, delay period and affecting factors, detonation and affecting factors, control and comparison with knocking of S.I. engines.	10
Module – III Elementary carburetor and its auxiliary devices, Choke jet ratio of a simple carburetor, MPFI system. Injection system of C.I. engines. Introduction to supercharging and its purpose. Engine Cooling: Introduction to air- and water-cooling systems. Lubrication: Objectives and Properties of lubricating oil, Mechanism of lubrication, Role of Additives.	8
Module - IV Testing and performance: Measurement of air, fuel consumption, indicated power, brake power, Morse test, Heat balance sheet, Performance parameter of S.I. and C.I. engine, performance map. Engine Emission and control: Engine emissions and their effects, gasoline and diesel emission, methods of measuring pollutants, controlling of engine emission.	8
Module –V Gas turbine and Jet Propulsion: Theory of gas turbine, thermodynamic analysis of Brayton cycle, and with regeneration, reheat, inter-cooling. Compressor and turbines isentropic efficiency, Analysis of cycle considering losses. Jet propulsion cycle, elementary idea of turbojet, Turbo-propulsion, ramjet and pulses jet, Classification of Rocket propulsion.	8

Reference books:

4. A course in Internal Combustion Engines by M.L. Mathur and R.P. Sharma.
5. Internal Combustion by V. Ganeshan, McGraw Hill
6. Gas Turbine Jet and Rocket Propulsion by M.L.Mathur and R.P.Sharma
7. Spreadbury.F.G., Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.

Text books:

1. Internal combustion engines by E.F.Obert.
2. Gas turbine Theory by Cohen Roger
3. Kohli P L., “Automotive Electrical Equipment”, Tata McGraw Hill Publishing Co., Delhi, 2004

4. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.

COURSE INFORMATION SHEET

Course code:	ME 347(Program Elective-2)
Course title:	Advance Thermodynamics
Credits:3	(L: 3, T:1, P: 0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	5
Branch:	Mechanical Engineering

Syllabus

Module	Hours
Module –I Introduction: Importance of combustion, combustion equipment hostile fire problems, pollution problems arising from combustion. Thermodynamics of Combustion: Enthalpy of formation, enthalpy of reaction, heating values, first and second law analysis of reacting systems, chemical equilibrium, equilibrium composition, adiabatic and equilibrium flame temperature.	8
Module –II Kinetics of Combustion: Law of mass action, reaction rate, simple and complex reactions, reaction order and molecularity, Arrhenius Law, activation energy, Chain reaction steady state and partial equilibrium approximations. Chain explosion, Explosion limits and oxidation characteristics of hydrogen, carbon monoxide and hydrocarbons.	8
Module – III Flames: Premixed Flames: structure and propagation of flames in homogeneous gas mixtures; simplified Rankine-Hugoniot relations; properties of Hugoniot curve; analysis of deflagration and detonation branches, properties of Chapman Jouguet wave. Laminar flame structure; theories of flame propagation and calculation of flame speeds, flame speed measurements. Stability limits of laminar flames; flammability limits and quenching distance; burner design. Mechanisms of flame stabilization in laminar and turbulent flows; flame quenching. Diffusion flames; comparison of diffusion with premixed flame. Combustion of gaseous fuel jets Burke and Schumann development.	8
Module – IV Burning of Condensed Phase: General mass burning considerations, combustion of fuel droplet in a quiescent and convective environment. Introduction to combustion of fuel sprays. Ignition: Concepts of ignition, chain ignition, thermal spontaneous ignition, forced ignition.	8
Module –V Combustion Generated Pollution & its Control: Introduction, nitrogen oxides thermal fixation of atmospheric nitrogen prompt NO, thermal NOx formation and control in combustors Fuel NOx and control, post-combustion destruction of NOx, Nitrogen dioxide carbon monoxide oxidation -quenching, hydrocarbons, sulphur oxides.	8

Text books:

1. An Introduction to Combustion, concepts and applications by S. R. Turns, McGraw Hill (2000).
2. Principles of Combustion by K. K. Kuo, John Wiley (2005).

Reference books:

1. Combustion Physics by C.K. Law, Cambridge University Press (2010).
2. Combustion Theory by F.A., Williams Addison Wesley (2007).

COURSE INFORMATION SHEET

Course code: ME 349(Programme Elective -2)
Course title: Turbo Machinery
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to turbomachines, classification of turbomachines, momentum, and moment of momentum theory applied to moving blades, change in total enthalpy and total pressure, velocity triangles for radial and axial flow turbomachines. Basic aerofoil theory applied to axial flow blades, non-dimensional performance parameters, specific speed, flow coefficient and head coefficient.	8
Module –II Steam and gas turbines: Steam flow through nozzles, critical pressure ratio, and choking of nozzles, throat and exit areas for optimum discharge, impulse and reaction stage, flow of steam through turbine blades, velocity diagrams, stage and other efficiencies, condition for maximum efficiency of a single stage turbine, compounding of steam turbines. Axial flow gas turbines, turbine characteristics and performance, simple design calculations.	8
Module – III Centrifugal and Reciprocating compressors: Compressor components and their function, the compression process, work required, polytropic efficiency, pressure rise, slip, effect of blade shape, two dimensional flow through impeller, vaned diffuser and volute casing, surging and choking of compressors, compressor performance and characteristic curves, simple design calculations.	8
Module – IV Axial flow compressors: Cascade analysis, vortex theory, work required, polytropic efficiency, pressure rise, degree of reaction, simple design calculations, surging and stalling of compressors, compressor performance and characteristic curves.	8
Module –V Fans and Blowers: Classification, construction and power requirement, pressure rise, efficiency calculations, applications in boilers, cooling towers, reversible fans and blowers, and other industrial applications, simple design calculations.	8

Text Books:

- T1. Turbines, Compressors & Fans, S. M. Yahya, Tata-McGraw Hill Co.
- T2. An Introduction to energy conversion, Volume III - Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd.
- T3. Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company .

Reference Books:

- R1. Fluid Mechanics and Thermodynamics of Turbomachinery, S. L. Dixon.
- R2. Fundamentals of Turbomachinery, William W Perg, John Wiley & Sons, Inc.
- R3. A Text book of Turbomechanics-, M.S.Govindgouda&A.M.Nagaraj-M.M.Publications.

COURSE INFORMATION SHEET

Course code: ME 351
Course title: Finite Element Methods
Credits: 3 L:3, T: 0, P:0
Class schedule per week: 03
Class: B.Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
MODULE: I Overview of Engineering systems: Continuous and discrete systems. Introduction to finite element method.	8
MODULE: II Energy methods: Variational principles and weighted residual techniques (least square method, collocation, sub-domain collocation, Galerkin method) for one-dimensional equation, Rayleigh-Ritz Formulation.	8
MODULE: III Energy methods: Development of bar and beam element, application to truss and frames.	8
MODULE: IV Finite elements for two-dimensions: Equivalence between energy formulation and Galerkin approach, discretization concepts, choice of elements, derivation of element shape functions (Lagrangian and Hermite) in physical coordinates, Iso-parameteric mapping, numerical integration.	8
MODULE: V Generate shape function and natural coordinates; solving finite element problems using code/software.	8

TEXT BOOKS:

1. S.S. Rao, *The Finite Element Method in Engineering*, 5th Ed., Butterworth-Heinemann, 2012.
2. T.R. Chandrupatla, A.D. Belegundu, *Introduction to Finite Elements in Engineering*, 3rd Ed., PHI Learning Pvt. Ltd, 2002.
3. R.D. Cook, D.A. Malkus, M.E. Plesha, R.J. Witt, *Concepts and Applications of finite element analysis*, John Wiley & Sons, 4th edition, 2002.

REFERENCE BOOK:

1. D.L. Logan, *A First Course in Finite Element Method*, Fourth Ed., Cengage Learning, 2007.

COURSE INFORMATION SHEET

Course code: ME 353(Program Elective-2)
Course title: Computational Fluid Dynamics
Credits: 3 (L: 3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I Governing equations; conservative and non-conservative forms of equations; models of flow.	8
Module –II Mathematical classification of Partial differential equations; Elliptic, Parabolic and hyperbolic equations; linear and non-linear PDE; initial and boundary conditions.	8
Module – III Basic aspects of discretization: finite difference approximations by forward, backward and central differencing upto fourth order accuracy.	8
Module – IV Consistency analysis; linearization; Explicit and Implicit Schemes, Error analysis.	8
Module –V Stability Analysis: Discrete Perturbation Stability Analysis; Von-Newmann Stability Analysis, Case study on Lid Driven Cavity problem.	8

Text Books:

1. Computational Fluid Dynamics – The Basics with Applications (J. D. Anderson Jr.)
2. Computational Fluid Dynamics (J. D. Anderson)

Reference books

1. Computational Fluid Dynamics – Principles and Applications (J. Blazek)
2. Numerical Computation of Internal and External Flows (C. Hirsch)

COURSE INFORMATION SHEET

Course code: ME 355(Program Elective-2)
Course title: Advanced solid Mechanics
Credits: 3 (L: 3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I Review of basic concepts and equations in mechanics; Theory of 3D stress; Equilibrium equations in different types of coordinate systems; Stress transformation; Mohr’s circle for stress in three dimensions; Principal stresses; Boundary conditions; Theory of 3D Strains; Strain transformation; Compatibility equations; Generalized Hooke’s law.	8
Module –II Concept of elastic stability; Introduction to Beam-column: Equations, Beam-column with several concentrated loads, Beam-column with end couple; Buckling of columns by energy method, approximate calculation of critical load by energy method; Columns with variable cross sections.	8
Module – III Pure bending; Asymmetrical bending of straight beams; Inelastic bending of beam; Plastic bending; Plastic hinge; Plastic analysis of beams.	8
Module – IV Torsion of circular shaft; Torsion of bars of any cross-section; St. Venant’s theory; Prandtl’s method; Solutions for circular and elliptical cross-sections; Torsion of rectangular bar; Torsion of thin walled tubes.	8
Module –V Thermal stress; Thermo elastic stress-strain relations; Analysis of stress in: thin circular disks with symmetrical temperature variation, Long circular cylinder when temperature is symmetrical about the axis, Spheres with purely radial temperature variation, curved beam due to thermal loading.	8

Text Books:

3. Advanced Mechanics of Solid by L.S. Srinath, Tata Mc-Graw-Hill.
4. Advanced Mechanics of Materials by **Richard J. Schmidt** and **Arthur P. Boresi**, Wiley.
5. Mechanics of Materials by James M. Gere and Stephen P. Timoshenko, C B S Publishers & Distributors Pvt. Ltd.

Reference Books:

1. Theory of Elastic stability by S. Timoshenko & G. H. Gere.
2. Introduction to Solid Mechanics by I.H. Shames, J. M. Pitarresi, Prentice-Hall

COURSE INFORMATION SHEET

Course code: ME 357(Program Elective-2)
Course title: Measurement and Instrumentation
Credits: 3 L:3, T:0, P:0
Class schedule per week: 2
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Measurements systems, Static characteristics of instruments, Errors in measurements and its statistical analysis, Dynamic characteristics of instruments and measurement systems.	8
Module –II Primary sensing elements and transducers: Classification and characteristics of transducers, Mechanical devices, Electric transducer: Resistance, Inductance and Capacitance based, Thermal sensitive devices, Strain gauges, LVDT and RVDT, Synchros and Resolvers, Piezo-Electric, Hall effect, Optoelectronic devices, Semiconductor devices, Polarized light, Radiometry, Digital devices.	8
Module – III Signal conditioning: Op-Amp circuits, Differential amplifier, Amplitude modulation and demodulation, Filters and its types, Current sensitive circuits, A/D and D/A circuits. Display devices and recorders.	8
Module – IV Metrology: Measurement of length and angle, Dimensional measurements and standards, Gauges, Comparators, Interferometry, Optical flat, Measurement of area. Pressure measurements: Mechanical and Electromechanical Gauges, Viscosity and Ionization gauges.	8
Module –V Strain gauges, calibration, temperature compensation, and associated circuitry. Force, Torque and Power measurements, Velocity and vibration measurements, Flow measurements and Temperature measurements. Special measurements: Level, Density, Viscosity, Nuclear radiation, pH, Humidity, Open loop and closed loop control.	8

TEXT BOOKS:

- T1. A. K. Sawhney and PuneetSawney, Mechanical Measurements and Instrumentation and Control, DhanpatRai and Co., 2016
- T2. R. K. Rajput, Mechanical Measurements and Instrumentation, S.K. Kataria& Sons, 2013
- T3. Helfrickand Cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI, 2011.

REFERENCE BOOKS:

- R1. D. Patranabis, Sensors and Transducers, PHI, 2003.
- R2. H. S. Kalsi, Electronic Instrumentation, McGraw Hill, 2017.

COURSE INFORMATION SHEET

Course code: ME 303
Course title: Mechanical Vibration
Credits: 3 (L: 3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I Review of free and forced vibration analysis of single degree of freedom system with and without damping; different types of damping used in practice (Viscous damping, eddy current damping, structural damping, dry friction damping, non- contact damping methods); rotor unbalance; whirling of rotating shaft; base excited vibration.	8
Module –II Free vibration analysis of two and three degrees of freedom system; derivation of equation of motion; matrix formulation; influence coefficient; flexibility matrix; stiffness matrix; coordinate coupling; principal coordinates; orthogonality of modes; Lagrange’s equation; Forced vibration analysis of two and three degrees of freedom system due to harmonic excitation; torsional vibration with two rotor masses.	8
Module – III Determination of natural frequencies and mode shapes of multi degrees of freedom system using exact method; Analysis of multi degrees of freedom system using numerical methods: Dunkerley’s method, Holzer’s method, Stodola’s method, Rayleigh-Ritz method, Method of matrix iteration.	8
Module – IV Introduction to the vibration of continuous systems; Lateral vibration of string; Longitudinal vibration of bar; Torsional vibration of uniform shaft; Transverse vibration of beams having different types of supports (Euler- Bernoulli beam.)	8
Module –V Experimental methods in vibration analysis; vibration measuring Instruments (vibrometer, accelerometer); vibration testing equipments: different types of vibration exciters; signal generators; frequency measuring instruments; system identification from frequency response; vibration signature analysis and preventive maintenance.	8

Text Books:

1. Theory of Vibration with Applications: W. T. Thomsom and Marie Dillon Dahleh, Pearson Education.
2. Introductory Course on Theory and practice of Mechanical Vibrations by J.S.Rao and K.Gupta, Wiley Eastern Ltd.

Reference Book

1. Mechanical vibrations by ThammaiahGowda, Jagadeesha T and D V Girish, McGraw Hill.

COURSE INFORMATION SHEET

Course code: ME 315
Course title: Heat and Mass Transfer
Credits: 3 (L: 3, T: 0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Basic concepts and laws of Heat Transfer, generalized heat conduction equation in cartesian; cylindrical and spherical coordinates; Contact thermal resistance; without internal heat generation for Simple and composite Plane wall, hollow cylinders and spheres; Critical thickness of insulation; variable thermal conductivity of plane wall; 1D steady state heat conduction for Plane wall, hollow cylinders and spheres; Transient heat conduction – lumped heat capacity analysis.	8
Module –II Extended surfaces (Fins): General equation, temperature distribution and heat transfer analysis, fin efficiency, effectiveness, variable area, circumferential fin. Radiation: Definition and laws of thermal radiation, black body and non-black surfaces, shape factor analysis, radiation heat transfer by electrical analogy approach, radiation shield, re-radiation surfaces.	8
Module – III Forced Convection: Governing Equations, Velocity and Thermal Boundary Layers, related dimensionless numbers, Empirical solutions of Laminar and Turbulent flow, flow past cylinder – External and Internal flows, Reynolds and Colburn analogies.	8
Module - IV Free convection: Boundary layer concept, Governing equations; Empirical solutions of Plates, cylinders and enclosed spaces. Combined free and forced convection. Boiling Heat transfer – Basic phenomenon and regimes.	8
Module –V Heat Exchanger: Classification, LMTD and NTU – effectiveness methods of analysis, correction factor, Fouling Factor, Single and multi-pass heat exchangers, Efficiency and Effectiveness. Mass Transfer: Introduction to Diffusion and Convective mass transfer, concentration, velocities and fluxes, Fick’s law of diffusion and diffusion coefficient, species conservation equation, steady state diffusion through stationary media and equimolar counter diffusion.	8

Text books:

6. Heat and Mass Transfer by J.P. Holman, Tata McGraw Hill
7. Heat and Mass Transfer by Yunus A. Cengel and A. J Ghajar, Tata McGraw Hill
8. Fundamentals of Engineering Heat and Mass Transfer by R. C. Sachdeva, New Edge Science Ltd., New Delhi
9. Heat Transfer by S. P. Sukhatme, Universities Press
10. Data Book: Heat and Mass Transfer by C.P. Kothandraman

Reference Books:

6. Principles of Heat Transfer by F. Krieth and M. S. Bohn, Cengage Learning USA
7. Heat Transfer by Ghoshdustidar, Oxford University Press.

8. Heat and Mass Transfer by P. K. Nag, McGraw Hill
9. Fundamentals of Heat and Mass Transfer by Incropera, Dewitt, Bergman and Lavine, John Wiley & Sons

COURSE INFORMATION SHEET

Course code:	ME 347(Program Elective-2)
Course title:	Advance Thermodynamics
Credits:3	(L: 3, T:1, P: 0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	5
Branch:	Mechanical Engineering

Syllabus

Module	Hours
<p>Module –I Introduction: Importance of combustion, combustion equipment hostile fire problems,pollution problems arising from combustion.</p> <p>Thermodynamics of Combustion: Enthalpy of formation, enthalpy of reaction, heating values, first and second law analysis of reacting systems, chemical equilibrium, equilibrium composition, adiabatic and equilibrium flame temperature.</p>	8
<p>Module –II Kinetics of Combustion: Law of mass action, reaction rate, simple and complex reactions, reaction order and molecularity, Arrhenius Law, activation energy, Chain reaction steady state and partial equilibrium approximations. Chain explosion, Explosion limits and oxidation characteristics of hydrogen, carbon monoxide and hydrocarbons.</p>	8
<p>Module – III Flames: Premixed Flames: structure and propagation of flames in homogeneous gas mixtures; simplified Rankine-Hugoniot relations; properties of Hugoniot curve; analysis of deflagration and detonation branches, properties of Chapman Jouguet wave. Laminar flame structure; theories of flame propagation and calculation of flame speeds, flame speed measurements. Stability limits of laminar flames; flammability limits and quenching distance; burner design. Mechanisms of flame stabilization in laminar and turbulent flows; flame quenching. Diffusion flames; comparison of diffusion with premixed flame. Combustion of gaseous fuel jets Burke and Schumann development.</p>	8
<p>Module – IV Burning of Condensed Phase: General mass burning considerations, combustion of fuel droplet in a quiescent and convective environment. Introduction to combustion of fuel sprays.</p> <p>Ignition: Concepts of ignition, chain ignition, thermal spontaneous ignition, forced ignition.</p>	8
<p>Module –V Combustion Generated Pollution & its Control: Introduction, nitrogen oxides thermal fixation of atmospheric nitrogen prompt NO, thermal NOx formation and control in combustors Fuel NOx and control, post-combustion destruction of NOx, Nitrogen dioxide carbon monoxide oxidation -quenching, hydrocarbons, sulphur oxides.</p>	8

Text books:

- An Introduction to Combustion, concepts and applications by S. R. Turns, McGraw Hill (2000).
- Principles of Combustion by K. K. Kuo, John Wiley (2005).

Reference books:

3. Combustion Physics by C.K. Law, Cambridge University Press (2010).
4. Combustion Theory by F.A., Williams Addison Wesley (2007).

COURSE INFORMATION SHEET

Course code: ME 349(Programme Elective -2)
Course title: Turbo Machinery
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to turbomachines, classification of turbomachines, momentum, and moment of momentum theory applied to moving blades, change in total enthalpy and total pressure, velocity triangles for radial and axial flow turbomachines. Basic aerofoil theory applied to axial flow blades, non-dimensional performance parameters, specific speed, flow coefficient and head coefficient.	8
Module –II Steam and gas turbines: Steam flow through nozzles, critical pressure ratio, and choking of nozzles, throat and exit areas for optimum discharge, impulse and reaction stage, flow of steam through turbine blades, velocity diagrams, stage and other efficiencies, condition for maximum efficiency of a single stage turbine, compounding of steam turbines. Axial flow gas turbines, turbine characteristics and performance, simple design calculations.	8
Module – III Centrifugal and Reciprocating compressors: Compressor components and their function, the compression process, work required, polytropic efficiency, pressure rise, slip, effect of blade shape, two dimensional flow through impeller, vaned diffuser and volute casing, surging and choking of compressors, compressor performance and characteristic curves, simple design calculations.	8
Module – IV Axial flow compressors: Cascade analysis, vortex theory, work required, polytropic efficiency, pressure rise, degree of reaction, simple design calculations, surging and stalling of compressors, compressor performance and characteristic curves.	8
Module –V Fans and Blowers: Classification, construction and power requirement, pressure rise, efficiency calculations, applications in boilers, cooling towers, reversible fans and blowers, and other industrial applications, simple design calculations.	8

Text Books:

1. Turbines, Compressors & Fans, S. M. Yahya, Tata-McGraw Hill Co.
- . An Introduction to energy conversion, Volume III - Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd.
- T3. Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company .

Reference Books:

1. Fluid Mechanics and Thermodynamics of Turbomachinery, S. L. Dixon.
2. Fundamentals of Turbomachinery, William W Perg, John Wiley & Sons, Inc.
3. A Text book of Turbomechanics-, M.S.Govindgouda&A.M.Nagaraj-M.M.Publications.

COURSE INFORMATION SHEET

Course code: ME 351
Course title: Finite Element Methods
Credits: 3 (L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B.Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I Overview of Engineering systems: Continuous and discrete systems. Introduction to finite element method.	8
Module –II Energy methods: Variational principles and weighted residual techniques (least square method, collocation, sub-domain collocation, Galerkin method) for one-dimensional equation, Rayleigh-Ritz Formulation.	8
Module – III Energy methods: Variational principles and weighted residual techniques (least square method, collocation, sub-domain collocation, Galerkin method) for one-dimensional equation, Rayleigh-Ritz Formulation.	8
Module – IV Finite elements for two-dimensions: Equivalence between energy formulation and Galerkin approach, discretization concepts, choice of elements, derivation of element shape functions (Lagrangian and Hermite) in physical coordinates, Iso-parametric mapping, numerical integration.	8
Module –V Generate shape function and natural coordinates; solving finite element problems using code/software.	8

TEXT BOOKS:

1. S.S. Rao, *The Finite Element Method in Engineering*, 5th Ed., Butterworth-Heinemann, 2012.
2. T.R. Chandrupatla, A.D. Belegundu, *Introduction to Finite Elements in Engineering*, 3rd Ed., PHI Learning Pvt. Ltd, 2002.
3. R.D. Cook, D.A. Malkus, M.E. Plesha, R.J. Witt, *Concepts and Applications of finite element analysis*, John Wiley & Sons, 4th edition, 2002.

REFERENCE BOOKS:

1. D.L. Logan, *A First Course in Finite Element Method*, Fourth Ed., Cengage Learning, 2007.

COURSE INFORMATION SHEET

Course code: ME 353(Program Elective-2)
Course title: Computational Fluid Dynamics
Credits: 3 (L: 3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I Governing equations; conservative and non-conservative forms of equations; models of flow.	8
Module –II Mathematical classification of Partial differential equations; Elliptic, Parabolic and hyperbolic equations; linear and non-linear PDE; initial and boundary conditions.	8
Module – III Basic aspects of discretization: finite difference approximations by forward, backward and central differencing upto fourth order accuracy.	8
Module – IV Consistency analysis; linearization; Explicit and Implicit Schemes, Error analysis.	8
Module –V Stability Analysis: Discrete Perturbation Stability Analysis; Von-Newmann Stability Analysis, Case study on Lid Driven Cavity problem.	8

Text Books:

1. Computational Fluid Dynamics – The Basics with Applications (J. D. Anderson Jr.)
2. Computational Fluid Dynamics (J. D. Anderson)

Reference books

1. Computational Fluid Dynamics – Principles and Applications (J. Blazek)
2. Numerical Computation of Internal and External Flows (C. Hirsch)

COURSE INFORMATION SHEET

Course code: ME 355(Program Elective-2)
Course title: Advanced solid Mechanics
Credits: 3 (L: 3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module –I Review of basic concepts and equations in mechanics; Theory of 3D stress; Equilibrium equations in different types of coordinate systems; Stress transformation; Mohr’s circle for stress in three dimensions; Principal stresses; Boundary conditions; Theory of 3D Strains; Strain transformation; Compatibility equations; Generalized Hooke’s law.	8
Module –II Concept of elastic stability; Introduction to Beam-column: Equations, Beam-column with several concentrated loads, Beam-column with end couple; Buckling of columns by energy method, approximate calculation of critical load by energy method; Columns with variable cross sections.	8
Module – III Pure bending; Asymmetrical bending of straight beams; Inelastic bending of beam; Plastic bending; Plastic hinge; Plastic analysis of beams.	8
Module – IV Torsion of circular shaft; Torsion of bars of any cross-section; St. Venant’s theory; Prandtl’s method; Solutions for circular and elliptical cross-sections; Torsion of rectangular bar; Torsion of thin walled tubes.	8
Module –V Thermal stress; Thermo elastic stress-strain relations; Analysis of stress in: thin circular disks with symmetrical temperature variation, Long circular cylinder when temperature is symmetrical about the axis, Spheres with purely radial temperature variation, curved beam due to thermal loading.	8

Text Books:

1. Advanced Mechanics of Solid by L.S. Srinath, Tata Mc-Graw-Hill.
2. Advanced Mechanics of Materials by **Richard J. Schmidt** and **Arthur P. Boresi, Wiley.**
3. Mechanics of Materials by James M. Gere and Stephen P. Timoshenko, C B S Publishers & Distributors Pvt. Ltd.

Reference Books:

1. Theory of Elastic stability by S. Timoshenko & G. H. Gere.
2. Introduction to Solid Mechanics by I.H. Shames, J. M. Pitarresi, Prentice-Hall

COURSE INFORMATION SHEET

Course code: ME 357(Program Elective-2)
Course title: Measurement and Instrumentation
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Measurements systems, Static characteristics of instruments, Errors in measurements and its statistical analysis, Dynamic characteristics of instruments and measurement systems.	8
Module –II Primary sensing elements and transducers: Classification and characteristics of transducers, Mechanical devices, Electric transducer: Resistance, Inductance and Capacitance based, Thermal sensitive devices, Strain gauges, LVDT and RVDT, Synchros and Resolvers, Piezo-Electric, Hall effect, Optoelectronic devices, Semiconductor devices, Polarized light, Radiometry, Digital devices.	8
Module – III Signal conditioning: Op-Amp circuits, Differential amplifier, Amplitude modulation and demodulation, Filters and its types, Current sensitive circuits, A/D and D/A circuits. Display devices and recorders.	8
Module – IV Metrology: Measurement of length and angle, Dimensional measurements and standards, Gauges, Comparators, Interferometry, Optical flat, Measurement of area. Pressure measurements: Mechanical and Electromechanical Gauges, Viscosity and Ionization gauges.	8
Module –V Strain gauges, calibration, temperature compensation, and associated circuitry. Force, Torque and Power measurements, Velocity and vibration measurements, Flow measurements and Temperature measurements. Special measurements: Level, Density, Viscosity, Nuclear radiation, pH, Humidity, Open loop and closed loop control.	8

TEXT BOOKS:

1. A. K. Sawhney and PuneetSawney, Mechanical Measurements and Instrumentation and Control, DhanpatRai and Co., 2016
2. R. K. Rajput, Mechanical Measurements and Instrumentation, S.K. Kataria& Sons, 2013
3. Helfrickand Cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI, 2011.

REFERENCE BOOKS:

1. D. Patranabis, Sensors and Transducers, PHI, 2003.
2. H. S. Kalsi, Electronic Instrumentation, McGraw Hill, 2017.

COURSE INFORMATION SHEET

Course code:	ME 302
Course title:	Heat Transfer Lab
Credits: 1.5	(L:0, T:0, P:3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	5
Branch:	Mechanical Engineering

List of experiments

1. To determine thermal conductivity of an insulating powder.
2. To determine the forced convection heat transfer rate from a pin fin and compare the temperature distribution with the estimated values.
3. To determine the emissivity of a test plate.
4. To find the heat transfer coefficient for dropwise and filmwise condensation.
5. To find heat transfer coefficient for different air flow rates through a pipe.
6. To find heat transfer coefficient for a constant air flow rate through a pipe with variable heat input.
7. To find the heat transfer coefficient of a vertical cylinder in natural convection.
8. To compare the overall heat transfer coefficient under parallel and counter flow conditions in a shell and tube heat exchanger.
9. To determine the thermal conductivity of a viscous liquid.
10. To determine the free convection heat transfer rate from a pin fin and compare the temperature distribution with the estimated values.
11. To demonstrate the super thermal conductivity by means of heat pipe demonstrator.
12. To calibrate a temperature sensor in temperature measurement test setup.

COURSE INFORMATION SHEET

Course code:	ME 304
Course title:	Internal Combustion Engine lab
Credits: 1.5	(L:0, T: 0, P:3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	5
Branch:	Mechanical Engineering

List of experiments:

1. Economic speed test on 4- stroke, 4- cylinder Ambassador Petrol Engine.
2. Energy auditing and volumetric efficiency of 4-stroke, 4-cylinder Maruti Zen Petrol Engine.
3. Economic load test on twin cylinder, 4- stroke Peter Kirloskar Diesel Engine.
4. Performance study on M.P.F.I. Petrol Engine using Morse test.
5. Performance study on 4-cylinder, 4-stroke Diesel Engine.
6. Combustion characteristics (P- θ) diagram for variable loads on Mahindra Diesel Engine.
7. Analysis of exhaust emission (NO_x, CO) of Diesel Engine.
8. Analysis of Exhaust emission (NO_x, CO) of petrol Engine.
9. Study of M.P.F.I./S.P.F.I./ Carburettor system.
10. Study of Wankel rotary Engine.
11. Study of open cycle gas turbine.
12. Port timing diagram of two- stroke, single- cylinder Diesel Engine.

COURSE INFORMATION SHEET

Course code: ME 306
Course title: Mechanical Engineering Lab II
Credits: 1 (L: 0, T: 0, P: 2)
Class schedule per week: 2
Class: B. Tech
Semester / Level: 5
Branch: Mechanical Engineering

List of Experiments:

1. Evaluate the overall Heat Transfer Coefficient (U_L), Heat Removal Factor (F_R) and Thermal Efficiency of the Collector (η) in Thermosyphonic mode of flow at different radiation level.
2. Evaluate the overall Heat Transfer Coefficient (U_L), Heat Removal Factor (F_R) and Thermal Efficiency of the Collector (η) in Thermosyphonic wind speed.
3. Determine the Centrifugal Fan Characteristics.
4. Determine and plot velocity distribution curves for all orifice conditions.
5. Determine and plot the performance characteristics of Gear Oil Pump operating at various flow rates and speed.
6. Determine the Miniscus Fluctuation by varying different parameters.
7. Determine the I.V. and P.V. Characteristics of PV Module with varying Radiation and Temperature level.
8. Determine the I.V. and P.V. Characteristics of Series and Parallel combination of PV Module.
9. Determine the effect of variation in the tilt angle and evaluate the voltage and current of PV Module Power.
10. Demonstrate Flow Visualization during a flow past a blunt body.
11. Determine the Pressure Distribution around a Cylinder kept in Cross Flow of air.
12. Determine the Hydrodynamic Boundary Layer over a flat plate.

SIXTH SEMESTER

COURSE INFORMATION SHEET

Course code: ME 305
Course title: Automobile Engineering
Credits: 3 (L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Automotive Electrical and Electronics System: Introduction to electrical system, Battery and Cranking Motor, The charging circuit, the starting and ignition system, Electronically assisted ignition system, Capacitive discharge ignition, Distributor-less ignition, Sensors and applications in automobiles, Pressure sensors, temperature sensors, Position sensors, Lambda sensors, Air flow sensors, Knock sensors, Actuators, Solenoids, stepper motors.	8
Module –II Mechanics of Motor Vehicle: Power for propulsion, rolling, air and grade resistance, traction and tractive effort, road performance curves, Acceleration, gradeability and draw par pull , calculation of maximum acceleration, maximum tractive effort and reactions for different drives.	8
Module – III Power Transmission Systems: General Arrangement of clutch, friction clutch, gear box, torque transmission. Fluid flywheel, sliding, constant and synchromesh type gear box, epicyclic gear box, live axle transmission, rear engine vehicles, type of axles, axle less transmissions, four wheel drive, torque converter, turbo transmitter converter, automatic transmission, Borg-Warner transmission, Automatic control.	8
Module - IV Drive Lines, Brakes and tyres: Universal Joint, Propeller shaft, Live rear axle, final drive, torque reaction, thrust systems, differentials, wheel bearing, front Axle and rear axle, Steering Mechanism and carriage unit, primary construction, Ackerman linkage, centre point steering, Axle construction, wheel alignments, independent and dead axle suspension, frame design, types and action of springs and dampers, chassis lubrication, Brakes, functions and methods of operation, types, linkages, hydraulic mechanism servo and power brakes, types of tyres and tubes.	8
Module –V Modern Technology and Microprocessors in Automobiles: Introduction to hybrid vehicles, components, applications, Introduction to electrical components used in hybrid and electric vehicles, configurations, introduction to energy storage requirements in hybrid and electric vehicles, battery based energy storage, fuel cell based energy storage, hybridization of different energy storage devices, Microprocessor and Microcomputer controlled devices in automobiles, instrument cluster, Voice warning system, travel information system, keyless entry system.	8

TEXT BOOKS:

- T1. Automotive Mechanic by W.H. Course.
- T2. Automotive Mechanics by Heitner.
- T3. Electric and Hybrid Vehicles: Design and Fundamental by Iqbal Hussein

4. Modern Electrical Equipment of Automobiles by Judge A.W

REFERENCE BOOKS :

1. The Motor Vehicles by D.S. Newton and Steeds.
2. Fundamental of motor vehicle technology by Hillier and Peter Coobes.
3. Propulsion System for Hybrid Vehicle by John M. Miller.
4. Automotive Electrical Equipments by Kohli P L

COURSE INFORMATION SHEET

Course code:	ME 307
Course title:	Robotics Engineering
Credits: 3	(L: 3, T: 0, P: 0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	6
Branch:	Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to Robotics Engineering. Degrees of Freedom for Open and Closed loop systems, Serial robot kinematics: Transformation matrices and homogeneous coordinates, Composite rotation matrix, Rotation about an arbitrary axis, Euler angle representation. Links, Joints and their parameters, Denavit-Hartenberg representation, Forward kinematics.	8
Module –II Inverse kinematics of serial robot: Geometrical and Algebraic Approach. Velocity analysis: Jacobian matrix, Acceleration analysis. Role of Jacobian in robot Statics. Gravity compensation. Trajectory planning: Cartesian and Joint space trajectories, Cubic, cosine, quintic and cycloidal trajectories, Path primitives: Line and Circle in space, Point to point and Continuous path trajectories.	8
Module – III Dynamics of serial robots: Lagrange-Euler formulation, Newton Euler approach, Motion equations of a manipulator. Inverse and Forward dynamics approaches.	8
Module - IV Parallel robot structures, Inverse kinematics of parallel robots, 3-RPS, 6-RPS and 6-RUS structures. Forward kinematics of parallel robot approaches, Introduction to Wheeled mobile robot and Ariel robot subsystems.	8
Module –V Classical Industrial robot systems, PUMA, and SCARA configurations, Robotic system integration, Industrial applications of robotics: Case studies. Advanced concepts: Compliant structures and Force control applications, Redundant systems and associated challenges, System Identification.	8

TEXT BOOKS:

1. Subir Kumar Saha, Introduction to Robotics, TMH, New Delhi, 2014.
2. John J. Craig, Introduction to Robotics, Pearson Education, 2011.
3. J. P. Marlett, Parallel Robots, Springer, 2006.

REFERENCE BOOKS:

1. Dilip K. Pratihar, Fundamentals of Robotics, Narosa Publishing House, 2016.
2. KS Fu, C. S. G Lee, R. Gonzalez, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill Education, 1987.
3. Bruno Siciliano and OussamaKhatib, Handbook of Robotics, Springer, 2016.
4. Saeed B. Niku, An Introduction to Robotics Analysis, Systems, Applications, Prentice-Hall, 2001.

COURSE INFORMATION SHEET

Course code: ME359 (Program Elective-3)
Course title: Power Plant Engineering
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction: Principal types of power plants, special features, Advantages and Limitations. Elements of Modern Power Station, Importance of central power station, Review of electricity generation and energy scenario in Indian as well as world context. Application and future trend of developments.	8
Module –II Thermal Power Plants: Major components, fuels and their properties, storage, preparation, handling and burning, Ash handling and dust collection, Air pre-heater, Feed water treatment plants, insulation, Heat balance of power plant, Modern development in steam boiler.	8
Module – III Diesel and Gas Turbine Power Plants: Introduction, various system required for operation of Diesel Power Plant. Components of gas turbine power plant, different arrangements, optimum design of Gas turbine unit for combined cycle plant, comparative study of diesel and gas turbine plants. Hydraulic Power Plants: Different types of hydraulic power plants, rain fall and run-off measurements and plotting of various curves for estimating power available with or without storage.	8
Module - IV Nuclear Power Plants: Nuclear Reactors, Types of reactors, Pressurized water reactors, boiling heater reactors, Heavy water-cooled and moderated (CANDU) reactor, Gas-cooled reactors, Liquid metal cooled reactors, Indian Nuclear power installations. Non-Conventional Power Plants: Geothermal power plants, Tidal power plants, Wind power plants, solar power plants	8
Module –V Combined operation of different power plants: Introduction, Advantages of combined working, load division between power stations, storage type hydro-electric power plant in combination with steam plant, Instrumentation and control. Economic Analysis: Difference between Base load and peak load plants, Different terms and definitions, Performance and operating characteristics of power plants, Load division, Tariff method for Electrical Energy.	8

Text Books:

1. Power Plant Engineering: by F.T. Morse.
2. P. K. Nag, Power Plant Engineering, Tata McGraw-Hill, 2008.
3. Power Plant Technology: by M.M.E. Wakil, McGraw Hill Publication.

Reference Books:

1. Power Plant Engineering: by Arora&Domkundwar, Dhanpatrai Publication
2. Power Plant Engineering: by K.K. Ramalingam, Scitech Publications.

COURSE INFORMATION SHEET

Course code: ME 361(Program Elective-3)
Course title: Combustion
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction: Importance of combustion, combustion equipment hostile fire problems, pollution problems arising from combustion. Thermodynamics of Combustion: Enthalpy of formation, enthalpy of reaction, heating values, first and second law analysis of reacting systems, chemical equilibrium, equilibrium composition, adiabatic and equilibrium flame temperature.	8
Module –II Kinetics of Combustion: Law of mass action, reaction rate, simple and complex reactions, reaction order and molecularity, Arrhenius Law, activation energy, Chain reaction steady state and partial equilibrium approximations. Chain explosion, Explosion limits and oxidation characteristics of hydrogen, carbon monoxide and hydrocarbons.	8
Module – III Flames: Premixed Flames: structure and propagation of flames in homogeneous gas mixtures; simplified RankineHugoniot relations; properties of hugoniot curve; analysis of deflagration and detonation branches, properties of Chapman Jouguet wave. Laminar flame structure; theories of flame propagation and calculation of flame speeds, flame speed measurements. Stability limits of laminar flames; flammability limits and quenching distance; burner design. Mechanisms of flame stabilization in laminar and turbulent flows; flame quenching. Diffusion flames; comparison of diffusion with premixed flame. Combustion of gaseous fuel jets Burke and shumann development.	8
Module - IV Burning of Condensed Phase: General mass burning considerations, combustion of fuel droplet in a quiescent and convective environment. Introduction to combustion of fuel sprays. Ignition: Concepts of ignition, chain ignition, thermal spontaneous ignition, forced ignition.	8
Module –V Combustion Generated Pollution & its Control: Introduction, nitrogen oxides thermal fixation of atmospheric nitrogen prompt NO, thermal NOxformation and control in combustors Fuel NOxand control , post-combustion destruction of NOx, Nitrogen dioxide carbon monoxide oxidation -quenching , hydro carbons, sulphur oxides	8

Text books:

1. An Introduction to Combustion, concepts and applications by S. R.Turns, McGraw Hill (2000).
2. Principles of Combustion by K. K. Kuo, John Wiley (2005).

Reference books:

1. Combustion Physics by C.K. Law, Cambridge University Press (2010).
2. Combustion Theory by F.A., Williams Addison Wesley (2007).

COURSE INFORMATION SHEET

Course code: ME 363(Program Elective-3)
Course title: Vehicle Dynamics
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Longitudinal dynamics: An introduction to vehicle dynamics, Vehicle Load Distribution – Acceleration and Braking -Brake Force Distribution, Braking Efficiency and Braking Distance - Longitudinal dynamics of a Tractor-Semi Trailer.	8
Module –II Tire mechanics and a simple tire model: An Introduction: Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development – Contact Patch and Contact Pressure Distribution, Lateral Force Generation - Ply Steer and Conicity -Tire Models – Magic Formula - Classification of Tire Models and Combined Slip.	8
Module – III Lateral Dynamics: Bicycle Model - Stability and Steering Conditions -Understeer Gradient and State space Approach – Handling Response of a Vehicle - Mimuro Plot for Lateral Transient Response - Parameters affecting vehicle handling characteristics.	8
Module - IV Vehicle Handling and Vertical Dynamics: Subjective and Objective Evaluation of Vehicle Handling, Rollover Prevention - Half Car Model - Quarter Car Model.	8
Module –V Vehicle Vibration: Basics of vibration, Lagrange’s method and dissipation function, Bicycle, car and body pitch mode, Full car vibrating model, Suspension optimization.	8

Text books:

1. H. B. Pacejka, Tyre and Vehicle Dynamics, Elsevier, 2nd Ed.
2. R. N. Jazar, Vehicle Dynamics: Theory and Application, Springer.
3. T. D. Gillespie, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers.
4. K. Popp and W. Schiehlen, Ground vehicle Dynamics, Springer-Verlag Berlin Heidelberg.

Reference books:

1. J. Reimpell, H. Stoll, and J. W. Betzler, The Automotive Chassis: Engineering Principles,

COURSE INFORMATION SHEET

Course code: ME367 (Programme Elective -3)
Course title: Industrial Tribology
Credits: 3 (L:3,T:0,P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Tribology Introduction and historical background, nature of engineering surfaces, Role of tribology in MEMS/NEMS, factors influencing tribological phenomena. Engineering surfaces- Surface characterization, Computation of surface parameters, Surface measurement techniques, Introduction to micro and nano tribology, Industrial significance and economic aspects.	8
Module –II Contact of engineering surfaces Hertzian and non-hertzian contact. Contact pressure and deformation in non-conformal contacts, Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, Various laws and theory of friction. Atomic scale understanding of friction, Surface forces (van der Waals, electrostatic, hydrogen bonding etc.), stick-slip phenomenon, friction anisotropy.	8
Module – III Wear Wear and wear types, Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage, wear controlling techniques.	7
Module - IV Lubrication Lubricant composition, lubricants types, physical and chemical properties, effect of temperature and pressure on viscosity, additive role and types, elements of lubrication, Lubrication regimes- Boundary Lubrication, Mixed Lubrication, Hydro dynamic lubrication.	9
Module –V Industrial applications Solution of tribological problems and recent developments, an overview of engineering materials having potential for tribological application, rolling element bearings, gears, crank shafts, piston rings, cylinder liners etc.	11

Text Book

1. M. Hutchings, Tribology: Friction and Wear of Engineering Materials, Edward Arnold, 1992.
2. K. C. Ludema, Friction, Wear, Lubrication: A Textbook in Tribology, CRC Press, 1996.
3. R. D. Arnell, P. Davies, J. Halling, and T. Whomes, Tribology Principles and Design Applications, MacMillan, 1991.

Reference Book

1. G Bayer, Mechanical wear prediction and prevention- Marcel Dekkar. Inc., New York.
2. B. Bhushan, Principles and Applications of Tribology, Willey –IEEE, 1999.
3. P. Sahoo. Industrial Tribology, Tata McGraw Hill.

COURSE INFORMATION SHEET

Course code:	ME365 (Program Elective-3)
Course title:	Design of Mechanisms
Credits: 3	(L:3, T:0, P:0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	6
Branch:	Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to Mechanisms and number synthesis: Mechanisms, Kinematic pairs, Plane and space mechanisms, Kinematic chains, Kinematic diagram, Kinematic Inversions, Equivalent linkage, Mobility and range of movement, Four and six link mechanisms.	8
Module –II Kinematic Synthesis 1: (Graphical methods) Motion generation with two and three prescribed points, Path generation with three and four points, Function generation with three precession points, The Overlay Method, (Analytical Methods) Complex number modelling in kinematic synthesis, The Dyad, Motion path and function generation with three prescribed points, Three precession point synthesis for multiloop mechanisms, Freudenstein’s equation for three point function generation, Loop-closer equation technique.	8
Module – III Kinematic Synthesis 2 and Curvature Theory: Motion generation with four prescribed points, Special cases of four position synthesis, Five position motion generation, Extensions of Burmester point theory for path and function generation, Geared linkages. Curvature theory: Fixed and moving centroide, Velocity and Acceleration, Inflection points and inflection circles, The Euler-Savary Equation, Bobillier’s construction, Hartmann’s construction, Cusp points.	8
Module - IV Dynamics of Mechanisms: Review kinetostatics using matrix method, Lagrange equation of motion, Force and moment balancing of linkages, Shaking moment balancing, Effect of moment balance on input torque, Analysis of high speed elastic mechanism.	8
Module –V Synthesis of Spatial Linkages: Matrix method for translation and rotation, Modelling and kinematic analysis of spatial mechanisms, Kinematic analysis of industrial robot.	8

Text books:

1. G. N. Sandor and A. G. Erdman, Advanced Mechanism Design: Analysis and Synthesis - Volume 2, Prentice Hall, New Jersey.
2. R. S. Hartenberg and J. Denavit, Kinematic Synthesis of Linkages, McGraw-Hill Book Company.
3. A. K. Mallik, A. Ghosh and G. Dittrich, Kinematic Analysis and Synthesis of Mechanisms, CRC Press.

Reference book:

1. A. G. Erdman, G. N. Sandor and S. Kota, Mechanism Design: Analysis and Synthesis - Volume 1, Prentice Hall, New Jersey.

COURSE INFORMATION SHEET

Course code: ME69 (Program Elective-3)
Course title: GAS DYNAMICS
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Fundamental of Gas Dynamics-energy equation, stagnation state and stagnation properties, bulk modulus of elasticity, sound velocity, Mach number, Mach angle, Bernoulli equation, isentropic flow with variable area , flow with variable area in adiabatic processes, area ratio as a function of Mach number, flow through convergent nozzles, divergent nozzle, numerical examples.	8
Module –II Flow with Normal Shock Waves- development of a normal shock wave, governing equations, mach number downstream of the normal shock wave, static pressure ratio across the shock, temperature ratio across the shock, density ratio across the shock (or) Rankine-Hugoniot equation, stagnation pressure ratio across the shock, change in entropy across the shock, impossibility of rarefaction shock wave, strength of a shock wave, numerical examples.	8
Module – III Fanno flow: Fanno curves, Fanno flow equations, solution of Fanno flow equations, variation of flow properties, change of entropy, variation' of mach number with duct length. Rayleigh flow: Rayleigh line, constant entropy lines, constant enthalpy lines, general equations in Rayleigh flow process, Rayleigh flow relations, variation of flow properties, maximum heat transfer. numerical examples.	8
Module - IV Jet Propulsion: Turbo jet, turbo prop engine, pulse jet engine, entropy relations and efficiencies of a turbo jet engine, thrust, propulsive, thermal and overall efficiencies, specific fuel consumption, specific thrust and specific impulse, effect of altitude, effect of forward speed, thrust augmentation, numerical examples.	8
Module –V Comparison between air breathing engines and rocket engines, classification of rocket engines, solid propellant rockets, liquid propellant rockets, hybrid rockets, mono propellants, fuel, oxidizer, properties of liquid and solid propellants, restricted burning, thrust and specific impulse, specific propellant consumption, weight flow coefficient, thrust coefficient, impulse to weight ratio, propulsive, thermal, overall efficiency, application of rocket engines, numerical examples.	8

TEXT BOOKS:

1. Gas Dynamics and Jet Propulsion, S.L. Somasundaram,, New Age International Publishers.
2. Aircraft Propulsion and Gas Turbine Engines, Ahmed F. El-Sayed, CRC Press.
3. Fundamentals of Compressible Flow, S. M. Yahya, New Age International Publishers.

4. Fundamentals of Gas Dynamics, V. Babu, Ane Books India.

REFERENCE BOOKS:

1. Fluid Mechanics, Fundamentals and Applications(S I Unit), Youns A. Cengel and John M. Cimbala, Tata Mc-Graw Hills Education Pvt. Ltd.
2. Rocker Propulsion Elements, G. P. Sutton, John Wiley, NY.
3. Elements of Gas Dynamics, H.W. Liepmann and A. Roshko, Dover Publications, New York.

COURSE INFORMATION SHEET

Course code:	ME 373(Program Elective-4)
Course title:	Design, Modelling and Application of Solar Energy
Credits: 3	(L:3, T: 0, P:0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	6
Branch:	Mechanical Engineering

Syllabus

Module	Hours
Module -I Design concepts of solar systems: System conceptual design, design of major components, overall system, design of physical principles to the solar system based on application. The process includes idea generation, concepts election and estimation, design of major components, and overall system design, solar radiation data.	8
Module –II Mathematical Modeling: overview of modelling – Types, stages, selection of modeling, Renewable Energy Devices and Systems equations, levels of analysis, steps in model development, solving and testing of models.	8
Module – III Computational Modeling: Computational modeling overview – Types, stages, selection of the modeling equations, levels of analysis, and steps in model development, solving and testing of models.	8
Module - IV Solar thermal energy storage: Design aspects of solar thermal energy storage systems. Selection criteria of storage materials for heating and cooling applications, selection of heat transfer fluid for heating and cooling applications. Case study of design and modelling of solar thermal energy storage-based system.	8
Module –V Solar photovoltaic system: Design of photovoltaic off-grid and grid- connected power systems. Design of system components - PV modules, batteries, charge controllers, inverters, auxiliaries. Case study of design and modelling of solar photovoltaic system.	8

Text Book

1. Solar Energy: Fundamentals and Applications by Garg&Prakash, H. P. Garg TMH Publication 2000.
2. Modelling and optimization of renewable energy systems. ArzuSencan. 2012. Intech publication ISBN : 978-953-51-0600-5

Reference Books:

1. Da Rosa. A.V, “Fundamentals of Renewable Energy Processes”, 2nd ed., Academic Press, 2009.
2. Bender. E.A, “Introduction to Mathematical Modeling”, Dover Publ., 2000
3. Fluid dynamics computational modeling and applications. Edited by L. Hector Juarez February 24th 2012 ISBN: 978-953-51-0052-2

COURSE INFORMATION SHEET

Course code: ME 375(Program Elective-4)
Course title: Power Gear Train
Credits: 3 (L:3, T: 0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Gear Drive: Principle of Transmission and Conjugate Action, Gear Materials, Spur Gear, Types of Gear Teeth, Beam Strength of Spur Gear, Effective tooth load, Contact stress and surface Durability	8
Module –II Helical Gears: Parameters of a Helical Gear, Virtual number of teeth on Helical Gears, Force components on a tooth of Helical Gear, Different strengths of Helical Gear tooth.	8
Module – III Straight Bevel Gears: Bevel Gear basic rack, spiral Bevel gears, Virtual no of teeth, Force analysis of Bevel gears, beam strength of Bevel gear tooth, wear strength of Bevel gear tooth, effective tooth load on Bevel gear, Spotts’s Equation for dynamic tooth load.	8
Module - IV Worm and Worm Wheel Set: Parameters of Worm gear set, Worm gear proportions, Force analysis in Worm and wheel set, Effect of rubbing velocity on friction in Worm wheel drive, Materials, Temperature rise of lubricating, Beam and wear strengths of worm wheel set.	8
Module –V Gearbox: Introduction, Resistance to vehicle motion, Types of gearboxes, sliding-mesh gear box, contact-mesh gearbox, synchromesh gearbox, epicyclic gearbox, Wilson gearbox, overdrive, five speed sliding mesh gearbox. Spread sheet applied to the design of Gear train, Gear train diagnostics based on noise and vibration. Case studies of power gear train in Automobiles & Overhead Cranes.	8

TEXT BOOK :

1. Machine Design by U. C. Jindal.

REFERENCE BOOK :

1. Julian Hapian-Smith, Introduction to Modern Vehicle Design, Butterworth Heinemann..

COURSE INFORMATION SHEET

Course code: ME 377(Program Elective-4)
Course title: Mechatronics
Credits: 3 (L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction : Definition of Mechatronics, Mechatronics in manufacturing products and design, Review of fundamentals of electronics, Gates and K map Minimization ,JK Flip Flop	8
Module –II Signal Conditioning :Mechatronics elements, Data Conversion Devices, Sensors and transducers, Microsensors, Signal processing Devices, Relays, Comparators, Filters, Timers, Transfer Systems , PLC’s programming	8
Module – III Processors Controllers and Drives: Microprocessors, Microcontrollers, Drives, Linear motion bearings, cams and ball screws, PID controllers, Closed Loop and Open loop	8
Module - IV Actuators : Servo motors, Stepper motors, Hydraulic actuators, Flow, Pressure and Direction control valves, Pneumatic Actuators, Distribution and conditioning of Compressed air, sytem components and graphic representations	8
Module –V CNC Technology and Robotics : CNC Machines and Part programming, Real time Systems, Industrial Robotics, Case Studies	8

Text book:

1. Introduction to Mechatronics and Measurement System by David G. Alciatore, Michael B. Histamd, McGraw Hill
2. Mechatronics by Bolton, Pearson Education

Reference books:

1. Mechatronics System Design by Devdas and Shetty, Pearson Education
2. CNC TECHNOLOGIES BY HMT LTD MGH

COURSE INFORMATION SHEET

Course code: ME 383(Program Elective-4)
Course title: Automation in Manufacturing
Credits: 3 (L: 3,T:0,P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Manufacturing automation, components and types of automation, CAD,CAM, Computer Control of Manufacturing Systems. Mechatronics in Manufacturing Systems. Modeling of Mechanical Systems for Mechatronics Applications, Automation Strategies in manufacturing industries.	8
Module –II Basic Principle, classification and structure of NC systems, NC-coordinate system, Constructional features and feedback devices for CNC machine tools, part programming (Fanuc), DNC and adaptive control.	8
Module – III Sensors, Actuators,Control System in manufacturing: Mechanical & Electric mechanical system, Pneumatics and hydraulics and servo control in CNC machine tools, Illustrative examples and case studies.	8
Module - IV Assembly Automation: Automatic Assembly Transfer Systems, Transfer mechanism, buffer storage and control functions for transfer devices, feeding mechanism definition and concept, AGV, AS/RS.	8
Module –V Flexible automation: Flexible manufacturing systems: concept, need, structure & operation, objectives and benefits. Quantitative Analysis of Flexible Manufacturing Systems, Quantitative Analysis in Cellular Manufacturing,CIM.	8

Text Books:

1. Automation, Production System, and CIM,M.P. Groover
2. CNCMachines,P. Radhakrishnan
3. System approach to Computer Integrated Design and Manufacturing: Nanua Singh

References Books:

1. Numerical Control of Machine Tools, Y. Koren
2. Manufacturing Technology II, P.N. Rao
3. Performance Modeling of Automated Manufacturing System : N. Viswannadham& Y Narhari

COURSE INFORMATION SHEET

Course code: ME 385(Program Elective-4)
Course title: Theory of Elasticity
Credits: 3 (L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B.Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Fundamentals of stress and strain: Introduction; Body force, surface force and stress vector; The state of stress at a point; Principal stresses; Mohr's circle; Stress invariants; Octahedral stresses; Hydrostatic and deviator stresses; The state of strain at a point; Cubical dilatation; Principal Strains; Generalised Hooke's law.	8
Module –II Derive governing equations of equilibrium; Boundary value problems; Equilibrium equations in cylindrical coordinates; Compatibility Equations.	8
Module – III Methods of Solution of Elasticity Problems – Plane Stress-Plane Strain Problems; Polar coordinates; Axisymmetric problems.	8
Module - IV Two dimensional problems: Airy's stress functions in rectangular coordinates; Investigation of Airy's Stress function for simple beam problems	8
Module –V Energy methods: Castigliano's theorem; approximate solution using Ritz method. Applications of energy methods to various problems.	8

TEXT BOOKS:

1. S.P Timoshenko, J.N. Goodier, Theory of Elasticity, 3rd Ed., McGraw-Hill Book Company, 1970.

REFERENCE BOOKS:

1. L.S. Srinath, Advanced Mechanics of Solids, 3rd Ed., Tata McGraw-Hill Ed. Pvt. Ltd., 2009.

COURSE INFORMATION SHEET

Course code:	ME387(Program Elective-4)
Course title:	Advanced Heat Transfer
Credits: 3	(L: 3, T:0, P: 0)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	6
Branch:	Mechanical Engineering

Syllabus

Module	Hours
Module -I Basic concepts and laws of Heat Transfer, Two-Dimensional Steady-State Conduction, Method of Separation of Variables, Conduction Shape Factor and the Dimensionless Conduction Heat Rate, Finite-Difference Equations, Transient Conduction: General Lumped Capacitance Analysis, Plane Wall with Convection, Radial Systems with Convection, Semi-Infinite Solid, Objects with Constant Surface Temperatures or Surface Heat Fluxes, Periodic Heating, Finite-Difference Methods	8
Module –II Extended surfaces (Fins), Fins of Non-uniform Cross-Sectional Area, circumferential fins. Radiation: Fundamental Concepts, radiation heat transfer by electrical analogy approach, Shape factor, Triangular enclosure, Applications.	8
Module – III Convection Boundary Layers, Boundary Layer Equations, Normalized Boundary Layer Equations, Boundary Layer Analogies, Flat Plate in Parallel Flow, Cylinder in Cross Flow, Sphere, Flow Across Banks of Tubes, Impinging Jets, Packed Beds, Convection Correlations: Noncircular Tubes and the Concentric Tube Annulus, Turbulent Flow in Circular Tubes, Flow in Small Channels, Combined Free and Forced Convection.	8
Module - IV Boiling and Condensation, Dimensionless Parameters, Boiling Modes, Pool Boiling, Pool Boiling Correlations, Forced Convection Boiling, Condensation: Physical Mechanisms, Laminar Film Condensation on a Vertical Plate, Turbulent Film Condensation, Film Condensation on Radial Systems, Condensation in Horizontal Tubes, Drop wise Condensation.	8
Module –V Mass Transfer: Introduction to Diffusion and Convective mass transfer: Significant parameters in convective mass transfer, application of dimensional analysis to Mass Transfer, Analogies among mass, heat, and momentum transfer, Convective mass transfer correlations, Mass transfer between phases, Simultaneous heat and mass transfer.	8

TEXT BOOKS:

1. Fundamentals of Heat and Mass Transfer by Incropera, F. P. and De Witt, D. P
2. Heat and Mass Transfer by P.K. Nag
3. Fundamentals of Engineering Heat and Mass transfer by R. C. Suchdeva
4. Heat and Mass Transfer by Yunus A. Cengel.
5. Data Book: Heat and Mass Transfer by C.P. Kothandraman

REFERENCE BOOKS:

1. Whitaker, S., Fundamental Principles of Heat Transfer, New York, Pergammon, 1997
2. Heat and Mass Transfer by F. Kids
3. Heat and Mass Transfer by J.P. Holman

COURSE INFORMATION SHEET

Course code: ME 381(Program Elective-4)
Course title: Design of Brake System
Credits: 3 (L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 6
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Types of brakes, Friction materials in brakes and their characteristics, Design of Brakes in Passenger cars / Vans: Weight transfer, effect of tire / road adhesion, wheel lock, brake efficiency / adhesion utilization.	8
Module –II Design of Brakes in Vehicle – trailer combinations: in light trailers, overrun brakes, centre axle trailer, chassis trailer.	8
Module – III Brake design Analysis: Brake and shoe Factors in different types of brakes, estimation by analytical methods, Thermal Effects in Friction Brakes (Thermal analysis and Heat Dissipation).	8
Module - IV Electronic brake systems: Features of Anti-lock brake system (ABS), Traction Control System, Electronic Stability Control, Adaptive Cruise Control, trailer Sway Control, Electronic Brake force Distribution (EBD).	8
Module –V Brake Noise: Sources, its analysis (using analytical approaches) and control, system response, modal analysis and variability in brake noise.	8

Text Books

1. Day A, Braking of Road Vehicles, Butterworth Heinmann (Elsevier).
2. Julian Happian-Smith, Introduction to Modern Vehicle Design, Butterworth Heinemann.

Reference Books

1. UweDausend, Bert J. Breuer, Advanced Brake Technology, SAE International.
Ronald W. Walker, High-Performance Brake Systems, Car Tech Incorporated.

COURSE INFORMATION SHEET

Course code:	ME 306
Course title:	Robotics and Automation Lab.
Credits: 1.5	(L:0, T:0, P:3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	6
Branch:	Mechanical Engineering

List of experiments:

1. Introduction to Industrial Robot (KUKA KR5 Arc): Frames, Safety, Teach Pendant, etc.
2. Identification of DH Parameters of KUKA KR5 Arc Robot from Technical Specifications and physical and software verification using RoboAnalyzer.
3. End-effector tool calibration and manual/CAD verification.
4. Robot Workspace/Base Calibration.
5. Robot programming for a pick and place operation.
6. Pneumatic Circuit Design for Automated Single Cylinder Reciprocating action.
7. Reciprocating Single Cylinder action using Electro-Pneumatic circuit.
8. Sequential Double Cylinder Reciprocating action using Electro-Pneumatic circuit.
9. PLC: Introduction to Ladder Logic Programming.
10. Programming PLC for Pick and Place Task.
11. Using MATLAB/SimMechanics for perform mechanical simulation.
12. Create and simulate a 2R robot in MATLAB/SimMechanics and control its position.

COURSE INFORMATION SHEET

Course code:	ME 310
Course title:	Automobile Engineering Lab
Credits: 1.5	(L: 0, T:0, P:3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	6
Branch:	Mechanical Engineering

List of experiments:

1. To study the construction details and general principles of two- stroke and four stroke CI and SI engines.
2. To study the fuel system of engines (carburettor and injector, injection pump, fuel pump, MPFI, SPFI and CRDi).
3. To study the engine lubrication and cooling system.
4. To study the super charging, electrical system and equipment's of an automobile.
5. To study the clutch, gearbox, torque converters.
6. To study the universal joint, back axle construction, propeller shaft and differential.
7. To study the mechanical hydraulic Servo and power operated braking systems.
8. To study the front axle, steering geometry and wheel alignment of a 4 wheel vehicle.
9. To study the springs, torsion bars, independent suspension and shock absorbers (coil leaf and dampers).
10. To study the tyres and wheel balancing.
11. Performance of a power steering system.
12. To study the charging and ignition system of an automobile.
13. Assembly and disassembly of 6-cylinder Diesel engine.