BIRLA INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM

(Effective from Academic Session: Monsoon 2019)

NAME OF THE PROGRAMME :

B.TECH

NAME OF THE DEPARTMENT :

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

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

Department Vision:

The Mechanical Engineering Department of Birla Institute of Technology, Mesra, Ranchi strives to be globally recognized for quality engineering education and research leading to well qualified engineers, academicians and researchers who are innovative, entrepreneurial and successful in achieving excellence in their field of study.

Department Mission

1. To impart quality education to the students and enhancing their knowledge and skills to be globally competitive Mechanical Engineers.
2. To maintain state of the art research facilities to provide its students and faculty to create, interpret, apply and disseminate knowledge with an understanding of the limitations.
3. To develop linkages and interaction with industry, R & D organisation and educational institution for excellence in consultancy practices, research and teaching.
4. To provide conducive environment for learning, creativity and problem-solving skill.

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 Teamwork**: 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 provide a quality under graduate education for students entering the mechanical engineering profession of seeking carriers in related fields.

2. To advance scientific knowledge through basic and applied research.

3. To disseminate technical information through scholarly publication, conferences and continuing education.

4. To enable to acquire knowledge of relevant technologies and multidisciplinary fields including broad social, ethical and environmental issues within which the engineering is practiced.

5. To develop problem solving approach using analytical abilities, effective communication skills and team work.

6. To create awareness and understanding related to social issues, apart from developing a sense of commitment to the community and profession with sincere involvement.

(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 teamwork:** 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.

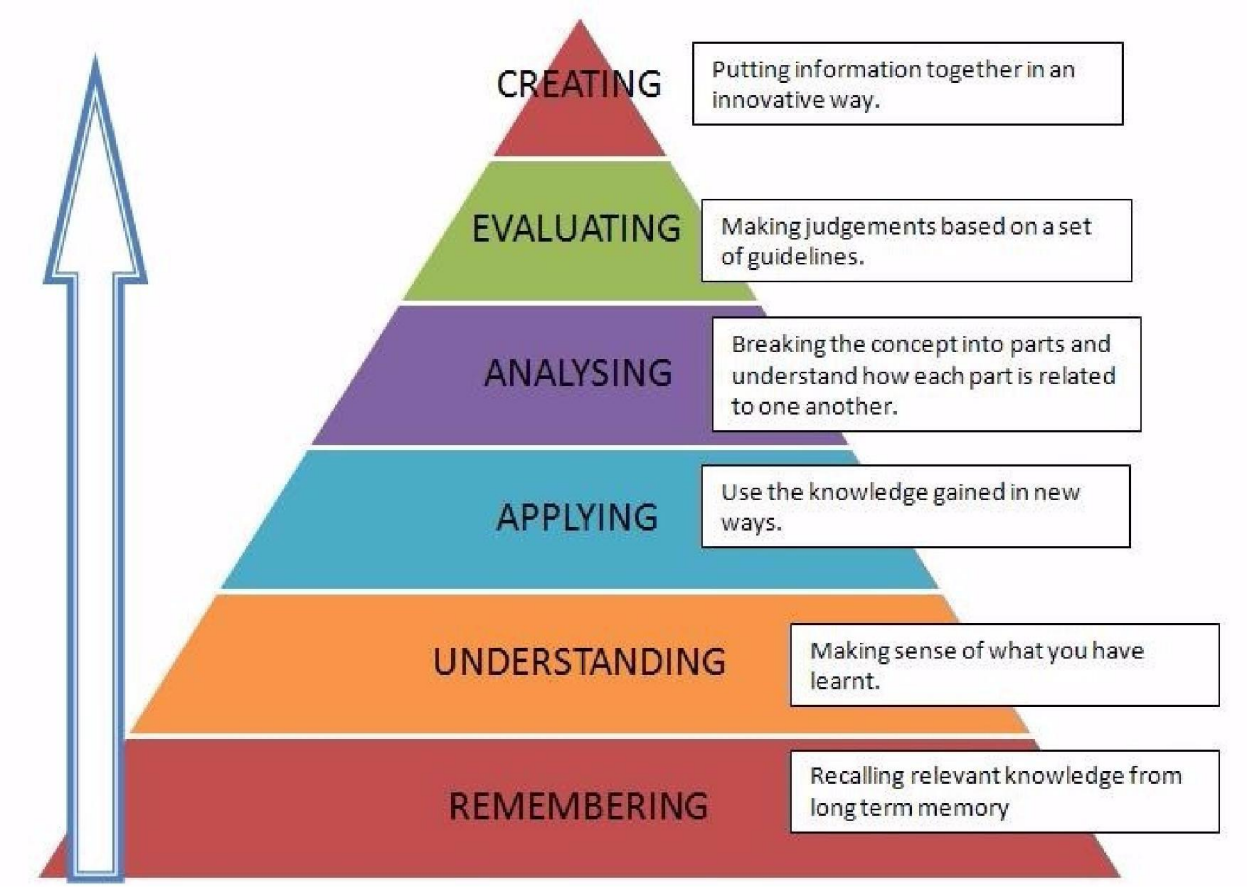
12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

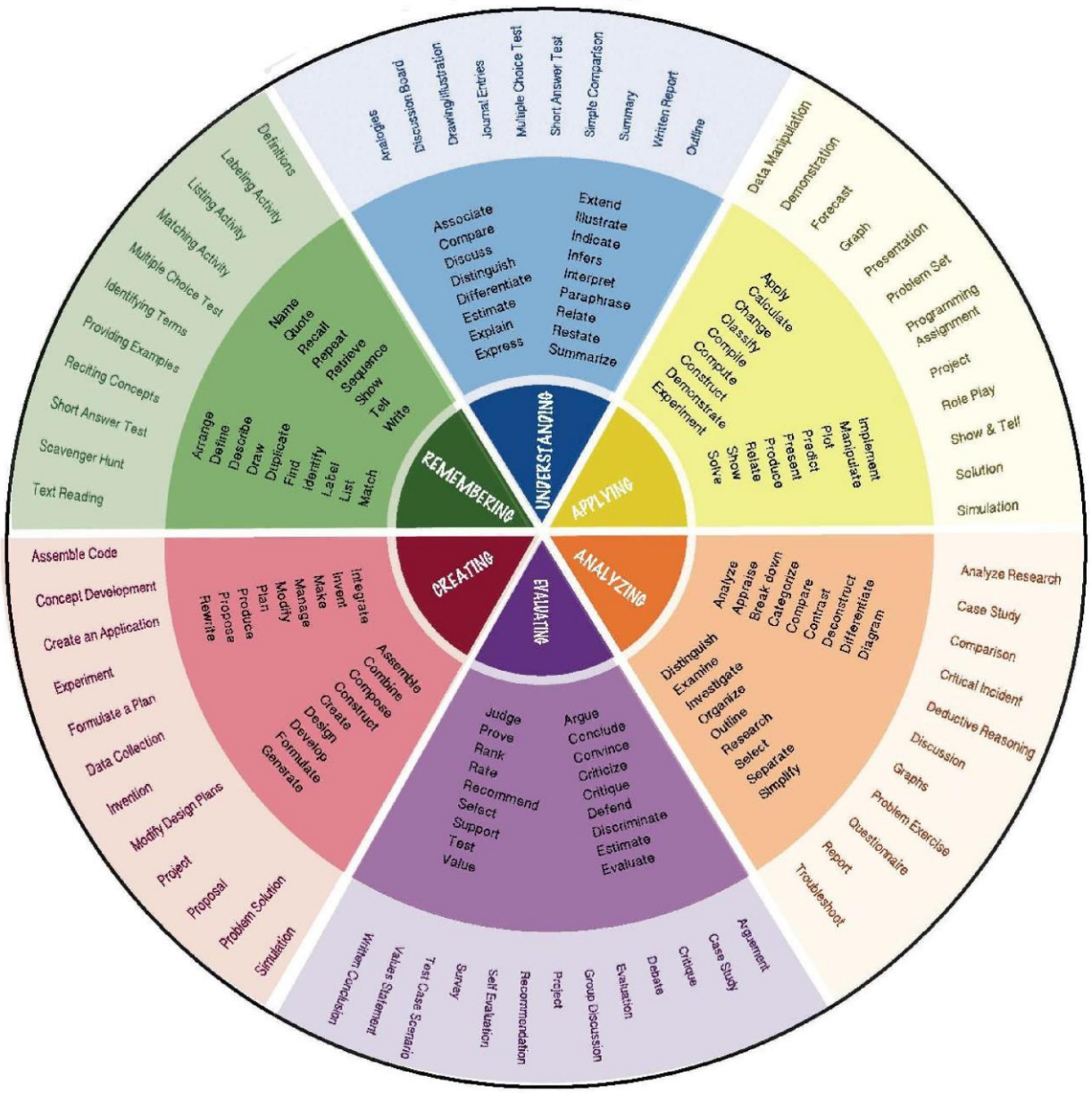
(B) Programme Specific Outcomes (PSOs)

1. The student will be able to design mechanical systems in various fields and challenges such as machine elements, thermal systems, manufacturing, and industrial and inter disciplinary fields like additive manufacturing, soft computing to meet the demand of the day in industry as well as society.
2. The student will be capable to start their entrepreneurship, be employable and suitable for various fields like design, manufacturing, production industries, academic and industries, research and development organizations in and outside the country.
3. The student will be able to pursue advanced degrees in engineering, business or other professional fields through their knowledge and learnt skills through formal as well as informal self-study and motivation.

BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:
Preamble

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




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

BIRLA INSTITUTE OF TECHNOLOGY- MESRA, RANCHI
NEWCOURSE STRUCTURE - To be effective from academic session 2019- 20 Based on CBCS & OBE Model
Recommended scheme of study
(For Mechanical Engineering Branch)

Semester/ Session of Study (Recommended)	**Course Level**	**Category of course**	**Course Code**	**Courses**	**Mode of delivery & credits** *L-Lecture; T-Tutorial;P-Practicals*			**Total Credits** *C-Credits*
					L (*Periods/ week*)	**T (*Periods/ week*)**	**P (*Periods/ week*)**	**C**
	THEORY							
FIRST Monsoon	**FIRST**	**FS *Foundation Sciences***	MA103	Mathematics - I	3	1	0	4
			PH113	Physics	3	1	0	4
		GE *General Engineering*	EE101	Basics of Electrical Engineering	3	1	0	4
			CS101	Programming for Problem Solving	3	1	0	4
	LABORATORIES							
	FIRST	**FS**	PH114	Physics Lab	0	0	3	1.5
		GE	CS102	Programming for Problem Solving Lab	0	0	3	1.5
		GE	PE101	Workshop Practice	0	0	3	1.5
		MC Mandatory Course	MC101/102/103/104	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
TOTAL								**21.5**
SECOND Spring	**THEORY**							
	FIRST	**FS**	MA107	Mathematics - II	3	1	0	4
			CH101	Chemistry	3	1	0	4
		GE	ME101	Basics of Mechanical Engineering	3	1	0	4
			EC101	Basics of Electronics & Communication Engineering	3	1	0	4
	LABORATORIES							
		FS	CH10	Chemistry Lab	0	0	3	1.5

			2					
	FIRST	**GE**	EC102	Electronics & Communication Lab	0	0	3	1.5
			ME102	Engineering Graphics	0	0	4	2
		MC	MC105/106/107/108	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
TOTAL								**22**
GRAND TOTAL FOR FIRST YEAR								**43.5**

Semester/ Session of Study (Recomended)	**Course Level**	**Category of course**	**Course Code**	**Courses**	**Mode of delivery & credits** *L-Lecture; T-Tutorial;P-Practicals*			**Total Credits** *C- Credits*
					L (*Periods/ week*)	**T *(Periods/ week)***	**P *(Periods/ week)***	**C**
	THEORY							
THIRD Monsoon	**SECOND**	**FS**	MA203	Numerical Methods	2	0	0	2
	FIRST		CE101	Environmental Sciences	2	0	0	2
	SECOND	**PC**	ME201	Thermodynamics	3	0	0	3
			ME203	Fluid Mechanics & Hydraulic Machines	3	0	0	3
			PE213	Manufacturing Processes	3	0	0	3
			ME205	Strength of Materials	3	1	0	4
	LABORATORIES							
	SECOND	**GE**	IT202	Basic IT Workshop	0	0	2	1
		FS	MA204	Numerical Methods Lab	0	0	2	1
		MC	MC201/202/203/204	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
			ME202	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5

		PC	ME204	Mechanical Engineering Lab I	0	0	3	1.5
TOTAL								**23**
FOURTH Spring	**THEORY**							
	SECOND	**GE**	IT201	Basics of Intelligent Computing	3	0	0	3
	FIRST	**FS**	BE101	Biological Science for Engineers	2	0	0	2
	SECOND	**PC**	ME207	Kinematics & Dynamics of Machines	3	0	0	3
			ME209	Energy Conversion Systems	3	0	0	3
			ME211	Machine Design	3	0	0	3
	SECOND	**PE**		Program Elective I	3	0	0	3
	LABORATORIES							
	FIRST	**GE**	EE102	Electrical Engineering Lab	0	0	3	1.5
	SECOND	**MC**	MC205/206/207/208	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA)	0	0	2	1
		PC	ME208	Dynamics of Machine Lab	0	0	3	1.5
			PE205	Manufacturing Processes Lab	0	0	3	1.5
TOTAL								**22.5**
FIFTH Monsoon	**THEORY**							
	FIRST	**HSS**	MT123	Business Communications	2	0	2	3
	THIRD	**PC**	ME301	I C Engines & Gas Turbines	3	0	0	3
			ME303	Mechanical Vibration	3	0	0	3
			ME315	Heat & Mass Transfer	3	0	0	3
		PE		Program Elective 2	3	0	0	3
		OE		Open Elective 1	3	0	0	3

	LABORATORIES							
	THIRD	**PC**	ME302	Heat Transfer Lab	0	0	3	1.5
			ME304	Internal Combustion Engine Lab	0	0	3	1.5
			ME 306	Mechanical Engineering Lab II	0	0	2	1
TOTAL								**22**
SIXTH Spring	**THEORY**							
	THIRD	**PC**	ME305	Automobile Engineering	3	0	0	3
			ME307	Robotics Engineering	3	0	0	3
		PE		Program Elective 3	3	0	0	3
				Program Elective 4	3	0	0	3
		OE		Open Elective 2	3	0	0	3
				Open Elective 3/MOOC I	3	0	0	3
		MC	MC300	Summer Training- Mandatory	N/A			2
	LABORATORIES							
	THIRD	**PC**	ME308	Robotics & Automation Lab	0	0	3	1.5
			ME310	Automobile Engineering Lab	0	0	3	1.5
TOTAL								**23**
	THEORY							
SEVENTH Monsoon	**FOURTH**	**HSS**	ME413	Professional Practice, Law and Ethics	2	0	0	2
		PC	ME401	Refrigeration & Air Conditioning	3	0	0	3
			ME403	Hydraulic & Pneumatic Control	3	0	0	3
			ME409	Industrial Management	3	0	0	3

			ME411	Computer Aided Design	3	0	0	3
		OE		Open Elective 4/MOOC II	3	0	0	3
	SECOND	**MC**	MT204	Constitution of India	2	0	0	NC
	LABORATORIES							
	FOURTH	**PC**	ME404	Refrigeration & Air Conditioning Lab	0	0	3	1.5
			ME406	Computer Aided Design & Drafting Lab	0	0	3	1.5
		PROJ	ME400 M	Minor Project	0	0	6	3
TOTAL								**23**
EIGTH Spring	**FOURTH**	**PROJ**	ME400	Research Project / Industry Internship	**Total**			**10**
GRAND TOTAL *Minimum requirement for Degree award*								**167**

PROGRAMME ELECTIVES (PE)
OFFERED FOR LEVEL 1-4

PE / LEVEL		Code no.	Name of the PE courses	L	T	P	C
2	PE 1	ME 251	Thermo Fluid Engineering	3	0	0	3
2		ME 253	Composite Materials	3	0	0	3
2		ME 255	Renewable Energy Resources	3	0	0	3
2		ME 257	Non Destructive Testing	3	0	0	3
3	PE 2	ME 347	Advanced Thermodynamics	3	0	0	3
3		ME 349	Turbo Machinery	3	0	0	3
3		ME 351	Finite Element Methods	3	0	0	3
3		ME 353	Computational Fluid Dynamics	3	0	0	3
3		ME 355	Advanced Solid Mechanics	3	0	0	3
3		ME 357	Measurement & Instruments	3	0	0	3
	PE 3	ME 359	Power Plant Engineering	3	0	0	3
3		ME 361	Combustion	3	0	0	3
3		ME 363	Vehicle Dynamics	3	0	0	3
3		ME 365	Design of Mechanisms	3	0	0	3
3		ME 367	Industrial Tribology	3	0	0	3
3		ME 369	Gas Dynamics	3	0	0	3
3	PE 4	ME 373	Design, Modeling and Application of Solar Energy	3	0	0	3
3		ME 375	Power Gear Train	3	0	0	3
3		ME 377	Mechatronics	3	0	0	3
3		ME 379	Reliability in MechanicalDesign	3	0	0	3
3		ME 381	Design of Brake System	3	0	0	3
3		ME 383	Automation in Manufacturing	3	0	0	3
3		ME 385	Theory of Elasticity	3	0	0	3
3		ME 387	Advanced Heat Transfer	3	0	0	3

DEPARTMENT OF MECHANICAL ENGINEERING
OPEN ELECTIVES (OE)*
OFFERED FOR LEVEL 1-4

OE / LEVEL	Code no.	Name of the OE courses	Prerequisites courses with code	L	T	P	C
2	ME 291	Renewable Energy Sources	NIL	3	0	0	3
2	ME 292	Smart & New Materials	NIL	3	0	0	3
3	ME 387	Motor Vehicle Acts	NIL	3	0	0	3
3	ME 391	Elements of Nuclear & Diesel Power Plant	NIL	3	0	0	3
3	ME 393	Elements of Hydel & Thermal Power Plant	NIL	3	0	0	3
4	ME 397	Industrial Robotics & Automation	NIL	3	0	0	3
4	ME 389	Mechatronics & its Applications	NIL	3	0	0	3

* OPEN ELECTIVES TO BE OPTED ONLY BY OTHER DEPARTMENT STUDENTS

COURSE INFORMATION SHEET

Course code: MA 103
Course title: Mathematics I
Credits: 4 (L: 3, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I 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
Module –II 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
Module –III 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 – Minima, Lagrange's method of multipliers.	9
Module –IV 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
Module –V 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 – divergence theorem, Stoke 's theorem.	9

Text Books:

1. M. D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 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: PH 113
Course title: Physics
Credits: 4 (L: 0, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module-I Physical Optics: Polarization, Malus' 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.	9
Module-II 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.	9
Module-III 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.	9
Module-IV 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.	9
Module-V 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.	9

Text books:

1. A. Ghatak, Optics, 4th Edition, Tata Mcgraw Hill, 2009
2. Mathew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2001
3. Arthur Beiser, Concept of Modern Physics, 6th edition, Tata McGraw- Hill, 2009

Reference book:

1. Fundamentals of Physics, Halliday, Walker and Resnick.

COURSE INFORMATION SHEET

Course code: EE 101
Course title: Basics of Electrical Engineering
Credits: 4 (L: 0, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I 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 Nonlinear magnetic circuits, Energy storage, A.C. excitation, Eddy currents and Hysteresis losses.	9
Module -II 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, Q–factor, Dynamic Impedance and Bandwidth.	9
Module -III 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.	9
Module -IV 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.	9
Module -V Working principles of AC Generators, motors and transformers, working principles of measuring equipments such as digital voltmeter, ammeter, power factor meter and wattmeter.	9

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.

COURSE INFORMATION SHEET

Course code: CS 101
Course title: Programming for Problem Solving
Credits: 4 (L: 0, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I 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.	9
Module -II Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals, Iterations, Loops.	9
Module -III 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.	9
Module -IV 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.).	9
Module -V Structures, Defining structures and Array of Structures Pointers: Defining pointers, Use of Pointers in self-referential structures, File Handling.	9

Text Books:

1. Jery R Hanly, Problem solving and Program design in C, 7thEdition, 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.

COURSE INFORMATION SHEET

Course code: PH 114
Course title: Physics Lab
Credits: 1.5 (L: 0, T: 0, P: 3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

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

COURSE INFORMATION SHEET

Course code: CS 102
Course title: Programming for Problem Solving Lab
Credits: 1.5 (L: 0, T: 0, P: 3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

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 $\sin x = x - x^3/3! + x^5/3! - x^7/7!$ ….. 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 nondigits) replaced by ‘*’.
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 + …… +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.

COURSE INFORMATION SHEET

Course code: PE 101
Course title: Workshop Practice
Credits: 1.5 (L: 0, T: 0, P: 3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

LIST OF EXPERIMENT:

1. MACHINE SHOP
   EXPERIMENT – I:Center Lathe
   Objective: To study lathe machine and to machine a given job on center lathe as per drawing.

2. MACHINE SHOP
   EXPERIMENT-II:Shaper Machine
   Objective: To study Shaper machine and to machine a given job on shaper as per drawing.

3. CARPENTRY SHOP
   EXPERIMENT-I: Carpentry Tools and Instruments
   Objective: To study the various tools, instruments and equipment used in carpentry practice.

4. CARPENTRY SHOP
   EXPERIMENT-II: Carpentry Practice
   Objective: To perform the carpentry work by making a wooden job using different tools.

5. FITTING SHOP
   EXPERIMENT-I:Fitting Tools and Measuring Instruments
   Objective: To study the various tools used in fitting shop and perform fitting operations (like marking, chipping, hack-sawing, filing, drilling etc.)

6. FITTING SHOP
   EXPERIMENT-II:Fitting Assembly Practice
   Objective: To make a job clamping plate as per given drawing by fitting operations and to check for its assembly with a given component.

7. FORGINGSHOP
   EXPERIMENT-I:Forging Tools
   Objective: To study different tools and equipment used in hand forging practice.

8. FORGINGSHOP
   EXPERIMENT-II: Forging Practice

Objective: To learn about hand forging practice by making a job (make a square bar from round blank and bend it at a sharp corner of 90 degree as per drawing).

9. FOUNDRY SHOP
   EXPERIMENT-I:Green Sand Moulding
   Objective: To get acquainted with various tools and equipment used in making green sand mould (to practice green sand mould making with single piece pattern).

10. FOUNDRY SHOP
    EXPERIMENT-II:Aluminium Casting
    Objective: To get acquainted with melting and pouring of metal in a mould (given two-piece patterns of handle) and to make aluminium casting.

11. WELDING SHOP
    EXPERIMENT-I:Manual Metal Arc Welding
    Objective: To study arc welding processes including arc welding machines (AC & DC), electrodes and equipment. To joint two pieces of given metal by arc welding process.

12. WELDING SHOP
    EXPERIMENT-II: Gas Welding
    Objective: To study gas welding processes including types of flames produced, filler metals and fluxes etc. To joint two pieces of given metal by gas welding process.

Books recommended:

TEXT BOOKS:

1. S K HajraChoudhury, A K. Hajra, “Elements of Workshop Technology:Vol- I and Vol -II”, Media PromotorsPvt Ltd.
2. B S Raghuwanshi, "A course in Workshop Technology", DhanpatRai Publications.

REFERENCE BOOKS;

1. P.N. Rao, “Manufacturing Technology Vol-1and Vol-II”, Tata McGraw Hill.
2. Kalpakjian, "Manufacturing Engineering and Technology", Pearson.

SECOND SEMESTER

COURSE INFORMATION SHEET

Course code: MA 107
Course title: Mathematics-II
Credits: 4 (L: 3, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 2
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I 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
Module -II 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
Module -III 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.	9
Module -IV 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.	9
Module -V 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.	9

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

Reference Books:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition ., Wiley India, 2009.

2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
4. G. F. Simmons, Differential Equations with Applications and Historical Notes, TMH, 2nd Edition, 2003.
5. P. L. Meyer: Introductory Probability and Statistical Applications, Oxford & IBH.

COURSE INFORMATION SHEET

Course code: CH 101
Course title: Chemistry
Credits: 4 (L: 3, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 2
Branch: Mechanical Engineering

Syllabus

Module	Hours
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.	9
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: cis–trans 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.	9
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.	9
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.	9
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.	9

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

COURSE INFORMATION SHEET

Course code: ME 101
Course title: Basics of Mechanical Engineering
Credits: 4 (L: 3, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 2
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I 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
Module –II 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'sprinciple –inertia force and inertia couple.	9
Module – III 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
Module - IV 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
Module –V 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

Text Books

1. Engineering Mechanics, Irving H. Shames, P H I. ltd, 2011.
2. Engineering Mechanics, S. Timoshenko, D. H. Young, J. V. Rao, SukumarPati, 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, DhanpatRai 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 – 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.

COURSE INFORMATION SHEET

Course code: EC 101
Course title: Basics of Electronics & Communication Engineering
Credits: 4 (L: 3, T: 1, P: 0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 2
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module –I 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 – Operation and Applications; Diode as a Rectifier: Half Wave and Full Wave Rectifiers with and without C-Filters.	9
Module –II 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.	9
Module –III Sinusoidal Oscillators: Concept of positive and negative feedback, Barkhausen criterion for sustained oscillations, Determination of Frequency and Condition of oscillation, Hartley and Colpitt's 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.	9
Module –IV 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.	9
Module –V 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.	9

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

COURSE INFORMATION SHEET

Course code: CH 102
Course title: Chemistry Lab
Credits: 1.5 (L: 0, T: 0, P: 3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

List of Experiments

1. Gravimetric estimation of Nickel by Dimethylglyoxime.
2. Quantitative estimation of Ca2+ and Mg2+ ions by complexometric titration using Na2- EDTA.
3. To verify Bears Law using Fe3+ solution by spectrophotometer/colorimeter and to determine the concentration of a given unknown Fe3+ 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.

COURSE INFORMATION SHEET

Course code: EC 102
Course title: Electronics & Communication Lab
Credits: 1.5 (L: 0, T: 0, P: 3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 1
Branch: Mechanical Engineering

List of 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. Boylstead R.L., Nashelsky L., Electronic Devices and Circuit Theory, 10th Edition Pearson Education, Inc.

COURSE INFORMATION SHEET

Course code: ME 102
Course title: Engineering Graphics
Credits: 2 **(**L:0, T:0, P:4)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 2
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to orthographic projections, Conventions, Fundamentals of First and Third Angle projection, Orthographic projections of points, lines and planes.	8
Module -II 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.	8
Module -III 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.	8
Module -IV 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.	8
Module -V Create views of engineering parts in AutoCAD, case studies with examples of Mechanical/ Electrical/Civil engineering drawings.	8

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, 2008

Reference Books

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

THIRG SEMESTER

COURSE INFORMATION SHEET

Course code: MA 203
Course title: Numerical Methods
Credits: 2 (L: 2, T:, P: 0)
Class schedule per week: 2
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering
Syllabus

Module	Hours
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.	5
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 eigen values.	5
Module –III Interpolation: Lagrange's interpolation, Newton's divided differences interpolation formulas, inverse interpolation, interpolating polynomial using finite differences.	5
Module –IV Differentiation and Integration: Differentiation using interpolation formulas, Integration using Newton-Cotes formulas: Trapezoidal rule, Simpson's rule.	5
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.	5

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 INFORMATION SHEET

Course code: CE 101
Course title: Environmental Science
Credits: 2 (L: 2, T:, P: 0)
Class schedule per week: 2
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module –I 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.	5
Module –II 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.	5
Module –III 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.	5
Module –IV Soil Pollution and Solid Waste Management: Lithosphere – composition, soil properties, soil pollution, ecological & health effects, Municipal solid waste management – classification of solid wastes, MSW characteristics, collection, storage, transport and disposal methods, sanitary landfills, technologies for processing of MSW: incineration, composing, pyrolysis.	5
Module –V 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.	5

Text books:

1. A, K. De. (3rd Ed). 2008. Environmental Chemistry. New Age Publications India Ltd.
2. R. Rajagopalan. 2016. Environmental Studies: From Crisis to Future by, 3rd edition, Oxford University Press.

3. Eugene P. Odum. 1971. Fundamentals of Ecology (3rd ed.) -. WB Sunders Company, Philadelphia.
4. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.
5. S.C. Santra. 2011. Environmental Science. New Central Book Agency.
Reference books:
1. D.W. Conell. Basic Concepts of Environmental Chemistry, CRC Press.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International.
3. G.M. Masters & Wendell Ela. 1991. Introduction to Environmental Engineering and Science, PHI Publishers.

COURSE INFORMATION SHEET

Course code: ME 201
Course title: Thermodynamics
Credits: 3 **(**L:3, T: 0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I 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.	8
Module –II 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 – III 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 - IV 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 –V 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* ofThermodynamics, John Wiley and Sons.

COURSE INFORMATION SHEET

Course code: ME 203
Course title: Fluid Mechanics and Hydraulic Machines
Credits: 3 L:3, T:0, P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I **Fluid statics:** Concept of continuum and physical properties of fluids, specific gravity, viscosity surface Tension, vapour pressure. Total pressure and centre of pressure, Measurement of pressure- Piezometer, U-tube and differential tube manometers, mechanical gauges	8
Module –II **Fluid kinematics :**Eulerian and Lagrangian description of fluid flow, 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, 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 applications.	8
Module – III **Closed conduit flow:**Reynold's experiment- Darcy Weisbach equation, Minor and major 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. Concept of Boundary layer, separation of boundary layer and its control.	8
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, working proportions, work done, efficiencies, draft tube theory and functions and efficiency. Performance of hydraulic turbines, geometric similarity, unit and specific quantities, governing of turbines, selection of type of turbine.	8
Module –V Centrifugal pumps : Classification, working, work done, manomertic head, losses and efficiencies, specific speed, pumps in series and parallel, performance characteristic curves, NPSH, Model studies, Reciprocating pumps, working, discharge, slip, indicator diagrams.	8

TEXT BOOKS :

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

REFERENCE BOOKS :

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

COURSE INFORMATION SHEET

Course code: PE 213
Course title: Manufacturing Processes
Credits: 3 **(**L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Casting: 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.	8
Module -II Theory of Metal Cutting: 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.	8
Module -III Machine Tools: Construction, operations and specifications of lathe and shaper. Construction, operations and specifications of milling & drilling machine. Introduction to grinding and types of grinding processes.	8
Module -IV Metal Deformation Processes: 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.	8
Module -V Welding: Principle, working and application of oxy- acetylene gas welding. Electric arc welding: MMAW/SMAW, SAW, GTAW and GMAW, Resistance welding. Soldering and Brazing.	8

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. HajraChoudhury, 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 McGraw Hill
4. M. C. Shaw, Metal Cutting Principles, Oxford University Press, Oxford, 1984.

COURSE INFORMATION SHEET

Course code: ME 205
Course title: Strength of Materials
Credits: 4 **(**L: 3, T:1, P:0)
Class schedule per week: 4
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I Stress at a point on a plane, Stress transformation equation, Principal stresses, Mohr's circle of stresses, Strain transformation equation, principal strain, strain rosette.	9
Module –II 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.	9
Module – III Deflection of Beam, Double integration method, Macaulay's method, Moment area method, Buckling of column.Strain energy method, Castigliano's theorem, application of energy method on different types of beamand thin circular ring.	9
Module - IV Shear Centre: Theory of shear flow, shear flow diagrams and shear center for thinwalledsymmetrical sections. Bending of curved beams: Beams of small and large initial curvature, evaluation ofcircumferential stresses.	9
Module –V 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.	9

Text Books:

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

Reference Book:

1. Mechanics of Materials by S. Timoshenko and James M. Gere.

COURSE INFORMATION SHEET

Course code: IT 202
Course title: Basic IT Workshop
Credits: 1 **(**L: 0, T:0, P:2)
Class schedule per week: 2
Class: B. Tech
Semester / Level: 3
Branch: Mechanical Engineering
Syllabus

Module	Hours
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.	5
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.	5
Module – III 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.	5
Module - IV Introduction to Python Basics: Basics, I Python, Data Types, Operators, Arrays, Plotting.	5
Module –V Python Programming Part 2: Functions and loops, object-oriented programming, Numerical Formalism.	5

Text Book

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 Book

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

COURSE INFORMATION SHEET

Course code:	MA 204
Course title:	Numerical Methods Lab
Credits: 1	**(**L: 0, T:0, P:2)
Class schedule per week:	2
Class:	B. Tech
Semester / Level:	3
Branch:	Mechanical Engineering

LIST OF EXPERIMENTS:

1. ASSIGNMENT – 1

Objective: 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. ASSIGNMENT – 2

Objective: 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. ASSIGNMENT – 3

Objective: Find a simple root of f (x) = 0 using Newton Raphson method. Read any initial approximation x0, maximum number of iterations n and error tolerance eps.

4. ASSIGNMENT – 4

Objective: Solution of a system of n x n linear equations using Gauss elimination method with partial pivoting. The program is for 10 x 10 system or higher order system.

5. ASSIGNMENT – 5

Objective: Matrix inversion and solution of n x n system of equations using Gauss-Jordan method. If the system of equations is larger than 15 x 15 change the dimensions of the float statement.

6. ASSIGNMENT – 6

Objective: 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 x0. If the system of equations is larger than 10 x 10 change the dimension in float.

7. ASSIGNMENT – 7

Objective: 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. ASSIGNMENT – 8

Objective: Program for Lagrange interpolation.

9. ASSIGNMENT – 9

Objective: Program for Newton divided difference interpolation

10. ASSIGNMENT – 10

Objective: Program for Newton's forward and backward interpolation

11. ASSIGNMENT – 11 Objective: Program for Gauss's central difference interpolation (both backward and forward).

12. ASSIGNMENT – 12
Objective: Program to evaluate the integral of f(x) between the limits a tob 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. ASSIGNMENT – 13
Objective: Program to evaluate the integral of f(x) between the limits a tob using Simpson's rule of integration based on 2n subintervals or 2n + 1 nodal points and the integrand is written as a function subprogram. The values of a, b and n are to be read. The program is tested for f(x) = 1/ (1 + x).

14. ASSIGNMENT – 14
Objective: Program to solve an IVP, dy/dx = f(x), y(x0) = y0 using Euler method. The initial value x0, y0, the final value xf and the step size h are to be read. The program is tested for f(x,y) = -2xy2 .

15. ASSIGNMENT – 15
Objective: Program to solve an IVP, dy/dx = f(x), y(x0) = y0 using 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. 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 INFORMATION SHEET

Course code:	ME 202
Course title:	Fluid Mechanics and Hydraulic Machines lab
Credits: 1.5	**(**L:0, T:0, P:3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	3
Branch:	Mechanical Engineering

List of experiments:

1. To determine the surface profile of liquid under free and forced vortex conditions.
2. To determine the centre of pressure of a plane surface under partial and submerged conditions.
3. To calibrate a Triangular notch.
4. To determine the coefficient of discharge through mouth pieces (convergent and divergent).
5. To determine the friction factor f for the turbulent flow through the commercial pipes of various sizes.
6. To study the effect of liquid jet impact on hemispherical and flat plate vanes.
7. To draw the characteristic curves of a Francis turbine.
8. To draw the characteristic curves of a Pelton turbine.
9. To draw the characteristic curves of a Modern Francis turbine (Mixed flow type).
10. To draw the characteristic curves of a multistage centrifugal pump.
11. To draw the characteristic curves of a reciprocating pump.
12. To draw the characteristic curves of a jet pump.

COURSE INFORMATION SHEET

Course code:	ME 204
Course title:	Mechanical Engineering Lab -I
Credits: 1.5	**(**L: 0, T:0, P:3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	3
Branch:	Mechanical Engineering

List of experiments:

1. To determine Brinell hardness number of mild steel
2. To determine Rockwell hardness number (HRC Scale) of hard steel.
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.
6. To determine forces in members of statically determinant truss
7. To determine forces in members of statically in-determinant truss
8. To determine the property of proving ring
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.
12. To determine the properties of Screw Jack
13. To determine the properties of Worm and Worm Wheel

COURSE INFORMATION SHEET

Course code: IT 201
Course title: Basics Of Intelligent Computing
Credits: 3 **(**L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I AI Concepts : Introduction to AI and Intelligent Agents, AI problems and Solution approaches, Problem solving using Search and Heuristics, AI Knowledge-base: creation, updation and reasoning, Broad category of branches in AI and intelligent Systems	8
Module –II Introduction to Soft Computing and Fuzzy Logic: Hard Computing: Features of Hard Computing, Soft Computing: Features of Soft Computing, Introduction to different Evolutionary Algorithms: Genetic Algorithm: Working Cycle of GA, Binary -Coded GA, Crossover, Mutation. Classical Sets Vs Fuzzy Sets, Representation of Classical Set, Representation of Fuzzy Set, Basic Properties of Fuzzy Sets , Fuzzy Set operations: Intersection, Union, Complement, Important Terminologies in Fuzzy set Operations, Properties of fuzzy sets, Fuzzy Relations and fuzzy Compositions: Operations on Fuzzy Relations, Max-Min Composition, Max-Product Composition, Max-Average Composition, Fuzzy Inference System: Fuzzification, Fuzzy Proposition, DefuzzificationMamdani Model, Fuzzy Logic Applications : Fuzzy Controllers, Antecedent/ Consequent variables, IF-THEN rules and Inference, Fuzzy Decision Making.	8
Module – III Introduction to Artificial Neural Networks: Development of ANNs, Biological Inspiration, Biological Neural Networks to ANN , Classification of ANN: NN Architecture, Learning/ Training, Training/ Testing Modes, Activation and Transfer Functions , First Generation Neural Network: Perceptron Network, Adaline, Madaline , Introduction to Second Generation Neural Networks: Backpropagation Training for Multi-Layer NN, Calculation of weights for Output-layer Neurons, Calculation of weights for Hidden-layer Neurons, Factors Influencing BPN training , Applications of Neural Network .	8
Module - IV Introduction to IoT: The IoT Paradigm, Concept of Things, IoTHardwares, IoT Protocols, IoT Architecture, enabling technologies of IoT, IoT Designing and its levels.	8
Module –V Introduction to Cloud Computing: Brief overview, historical developments, computing platform and technologies, element of distributed computing, virtualization: characteristics of virtualized environment, virtualization and cloud computing, pros and cons of virtualization, virtualization technologies, cloud	8

computing architecture: IAAS, PAAS, SAAS, types of cloud, cloud application.	

Text books:

1. Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
2. Buyya Raj Kumar, Vecchiola Christian &Selvi S. Thamarai , Mastering Cloud Computing, McGraw Hill Publication, New Delhi, 2013.
3. EngelbrechtAndries P., Computational Intelligence: An Introduction, Wiley.

Reference books:

1. Raj Pethuru and Raman AnupamaC.,The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press
2. KonarAmit, Computational Intelligence: Principles, Techniques and Applications, Springer.

COURSE INFORMATION SHEET

Course code: BE 101
Course title: Biological Sciences for Engineers
Credits: 2 **(**L:2, T:0, P:0)
Class schedule per week: 2
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I Basic Cell Biology: Origin of life, Cell theory, Cell Structure and function, Biomolecules, Cell cycle and cell division, Biological Organization.	5
Module –II Bioenergetics and Metabolism: Gibbs free energy and thermodynamics, aerobic and anaerobic respiration, Glycolysis, Krebs cycle and electron transport chain, Beta oxidation, Photosynthesis.	5
Module – III 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.	5
Module - IV Biological Signal Generation and Propagation: Nerve cell structure and signal propagation. Mechanism of vision and hearing, cell signaling, Circadian rhythm.	5
Module –V 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.	5

Text books:

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 books:

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.

COURSE INFORMATION SHEET

Course code: ME 207
Course title: Kinematics and Dynamics of Machines
Credits: 3 (L: 3, T: 0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering

Syllabus

Module	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.	8
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.	8
Module – III Balancing: Balancing of reciprocating and rotating masses, Two plane balancing, Balancing of inline, V tween, and radial engines.	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 of cam, Displacement diagram, Velocity and acceleration of follower, Graphical determination of cam profiles.	8
Module –V Gyroscope: Euler's equation of motion, Euler's modified equation of motion, Steady state, Stability of spinning top, ship, two wheeled and four wheeled vehicle.	8

Text books:

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

Reference Books:

1. John J. Uicker, Gordon R. Pennockand Joseph E. 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.

COURSE INFORMATION SHEET

Course code: ME 209
Course title: Energy Conversion Systems
Credits: 3 (L: 3, T: 0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module -I Vapour Power Cycle: Components of steam power system; Carnot vapour cycle and Rankine cycle; their comparisons; 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.	8
Module –II Fuels and Combustions: Classification of fuels; basic chemistry and combustion equations; conversion of volumetric to weight analysis and vise-versa; theoretical and excess air; Boiler performance: Equivalent evaporation; Boiler efficiency; Heat balance; Boiler Draught and its classification; Chimney height, maximum discharge and efficiency.	8
Module – III Steam Nozzles: Introduction; types of steam nozzles; nozzle efficiency; velocity of steam flow through the nozzle; discharge and condition of maximum discharge through a nozzle; physical significance of critical pressure ratio and choked flow; Supersaturated flow through nozzle; General relationship between area, velocity and pressure in nozzle flow.	8
Module - IV Steam Turbines: Classifications; compounding of turbines; working principle, velocity diagrams, diagram work and efficiency of impulse and reaction turbine; degree of reaction, Parsons turbine, condition for maximum efficiency impulse and reaction turbine; Losses in steam turbines, reheat factor and condition line; governing of steam turbine; Back-pressure and pass-out Turbine.	8
Module –V Steam condensers: Classification of condensers; sources of air leakage into the condenser; effects of air leakage in condenser; vacuum efficiency; condenser efficiency; cooling water calculations; Air ejector.	8

Text books:

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

Reference Books:

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

COURSE INFORMATION SHEET

Course code: ME 211
Course title: Machine Design
Credits: 3 **(**L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering
Syllabus

Module	Hours
Module- I Failure of materials: Principles of Machine Design, standardization, 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.	8
Module –II 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, Welded joints: Butt joints, Fillet joints, Strength of butt and fillet welds. Riveted joints: Types of rivet heads, types of rivet joints, Strength equations, Efficiency of joint, Caulking and fullering, Eccentrically loaded bolted, riveted and welded joints.	8
Module – III Design of brakes and clutches: Types of Brakes and Clutches, Clutch/Brake selection and specification, Clutch and Brake materials, Disc Clutches, Shoe, Band and Disk Brakes.	8
Module - IV Design of springs and bearing: Spring configuration, Spring materials, Design of helical compression/extension springs. Bearings, Types of sliding contact bearings, Bearing materials, Lubricating oils, Petroff's equation, Mckee's Investigation, Hydrostatic bearing, Rolling contact bearings.	8
Module –V Design of Gears: 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 gears, Lewis and Buckingham's equation, Effective load on spur gear tooth.	8

Text Books

1. Shigley's Mechanical Engineering Design, by Richard Budynas (Author), Keith Nisbett (Author)
2. Introduction to Machine Design by V. B. Bhandari
3. Machine Design by Khurmi

Reference Books:

1. Machine Design, An Integrated Approach by Robert L. Norton, Second Edition.
2. Machine Design Data Handbook by K. Lingaiah
3. Mechanical Design of Machine Components by Ansel C. Ugural

COURSE INFORMATION SHEET

Course Code: ME 251(PROG ELECTIVE-1)
Course Title: Thermo-Fluid Engineering
Credits: 3 **(**L: 3 T: 0 P: 0)
Class schedule per week: 3
Class: B. Tech.
Semester / Level: 4
Branch: Mechanical Engineering

Syllabus

Module	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.	8
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.	8
Module – III Navier-Stokes equation and its applications; energy equation and its applications to various problems.	8
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.	8
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.	8

Text Books:

1. D.F. Young, B.R. Munson and T.H. Okiishi, *A Brief Introduction to Fluid Mechanics*, 3rd Ed., 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*, 4th Ed., McGraw Hill, 2001.

Reference Books:

1. M.C. Potter and D.C. Wiggert, *Mechanics of Fluids*, 2nd Ed., Pearson Education, 1997.
2. D.A. Kaminski and M.K. Jensen, *Introduction to Thermal and Fluid Engineering*, John Wiley & Sons, Inc., 2017.

COURSE INFORMATION SHEET (PROG ELECTIVE-1)

Course code: ME 253
Course title: Composite Materials
Credits: 3 **(**L:3, T:0, P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering
Syllabus

Module	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.	8
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.	8
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.	8
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	8

mechanics, Laminate analysis, FE model and analysis	

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. P.M. Ajayan, L. Schadler, P.V. Braun Nano Composite Science and Technology, Wiley VCH, 2003.
4. E. Fitzer, L.M. Manocha, Carbon Reinforcement and Carbon/Carbon Composites, SpringerVerlag, Heidelberg, New York, 1998.
5. K.K. Chawla, Ceramic Matrix Composites, Kluwer Academic Publishers, 2003.
6. N. Chawla, K.K. Chawla, Metal Matrix Composites, Springer-Verlag, 2006.
7. 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

COURSE INFORMATION SHEET

Course code: ME 255(Program Elective-1)
Course title: Renewable Energy Sources
Credits: 3 (L: 3, T: 0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.	8
Module –II 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.	8
Module – III 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.	8
Module - IV 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.	8
Module –V 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.	8

TEXT BOOKS:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 1996.
2. Rai. G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
3. 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. Tiwari. G.N., Solar Energy – “Fundamentals Design, Modelling& Applications”, Narosa Publishing House, New Delhi, 2002.
3. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
4. Chetan Singh Solanki, Solar Photovoltaics, “Fundamentals, Technologies and Applications”, PHI Learning Private Limited, New Delhi, 2009.

COURSE INFORMATION SHEET

Course code: ME 257 (Program Elective I)
Course title: Non-Destructive Testing
Credits: 3 (L: 3, T: 0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to NDT and Visual Inspection and Liquid Penetrant Testing: Introduction and Classification of NDT, Visual Inspection Methods, Dye Penetrant Testing (DPT), Basic Principle of DPT, Types of dye and method of application, DPT-Developer application and Inspection.	8
Module –II Magnetic Particle Testing (MPT) & Eddy Current Testing (ECT): Basic definition of Magnetism & Principle of MPT, Magnetizing Techniques, Procedure & Equipment used for MPT, Applications & limitations of MPT. Principle & Instrumentation for ECT, Techniques used in ECT, Advanced ECT methods, Applications & limitations of ECT.	8
Module – III 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.	8
Module - IV Ultrasonic Testing: Basic Properties of Sound Beam, Ultrasonic Transducers, Inspection techniques, Flaw Characterization Techniques and Detection Equipment, Applications,	8

Advantages & Limitations of Ultrasonic Testing.	
Module –V Comparison and Selection of NDT methods: Defects in Materials, Selection of NDT Method, Selection of Instrumentation, Codes/Standards in NDT and Industrial Practices.	8

Text books:

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

Reference Books:

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

COURSE INFORMATION SHEET

Course code:	EE 102
Course title:	Electrical Engineering Lab
Credits: 1.5	(L: 0, T: 0, P: 3)
Class schedule per week:	3
Class:	B. Tech
Semester / Level:	4
Branch:	Mechanical Engineering

LIST OF EXPERIMENTS:

1. EXPERIMENT – 1: Measurement of low & high resistance of DC shunt motor Objective: (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. EXPERIMENT – 2: AC series circuit Objective: (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. EXPERIMENT – 3: AC parallel circuit Objective: (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. EXPERIMENT – 4: Resonance in AC RLC series circuit Objective: (i) To obtain the condition of resonance in AC RLC series circuit (ii) To draw phasor diagram
5. EXPERIMENT – 5: 3 phase Star connection Objective: (i) To establish the relation between line & phase quantity in 3 phase star connection (ii) To draw the phasor diagram.
6. EXPERIMENT – 6: 3 phase Delta connection Objective: (i) To establish the relation between line & phase quantity in 3 phase delta connection (ii) To draw phasor diagram.
7. EXPERIMENT – 7: 3 phase power measurement Objective: (i) To measure the power input to a 3-phase induction motor using 2 wattmeter method (ii) To draw phasor diagram.
8. EXPERIMENT – 8: Self & mutual inductance Objective: To determine self & mutual inductance of coils.
9. EXPERIMENT – 9: Verification of Superposition, Thevenin's and Reciprocity theorem Objective: (i) To verify Superposition theorem for a given circuit (ii) To verify Thevenin's theorem for a given circuit.
10. EXPERIMENT – 10: Verification of Norton's, Tellegen's and Maximum Power transfer theorem Objective: (i) To verify Norton's theorem for a given circuit (ii) To verify Maximum Power transfer theorem for a given circuit.

COURSE INFORMATION SHEET

Course code: ME 208
Course title: Dynamics of Machine Lab
Credits: 1.5 **(**L: 0, T:0, P: 3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 4
Branch: Mechanical Engineering
List of Experiments:

Experiment no. 1: Slider Crank Mechanism
Objective: Analyse velocity and acceleration of a Slider Crank Mechanism using graphical method and computer programming.
Experiment no. 2: Whitworth Quick-Return Mechanism
Objective: Analyse velocity and acceleration of a Whitworth Quick-Return Mechanism using graphical method.
Experiment no. 3: Coriolis component of acceleration
Objective: Determine the coriolis component of acceleration of the slider in a Crank and Slotted-Lever Mechanism.
Experiment no. 4: Instantaneous centres
Objective: Locate the instantaneous centres of a Whitworth Quick-Return and Crank and Slotted-Lever Mechanism.
Experiment no. 5: Hartnell Governor Objective: To determine the position of the sleeve against the controlling force and the speed of a Hartnell Governor, and also, plot the characteristics curve of the Hartnell Governor.
Experiment no. 6: Balancing Objective: Balancing of reciprocating masses (Demo experiment).
Experiment no. 7: Wheel balancing Objective: Balancing of wheel (Demo experiment).
Experiment no. 8: Cam profile, Objective: Draw the cam profile for the cycloidal motion of follower.
Experiment no. 9: Cam follower mechanism Objective: To construct displacement diagram for cam follower mechanism and to determine jump speed against different inertia of the follower.
Experiment no. 10: Gyroscope Objective: To study the gyroscopic couple due to simultaneous spin and precession of a disc.

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.

COURSE INFORMATION SHEET

Course code: PE 205
Course title: Manufacturing Processes -I Lab
Credits: 1.5 (L:0,T:0,P: 3)
Class schedule per week: 3
Class: B.Tech
Semester / Level: 4
Branch: Mechanical Engineering

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.

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. EngineCooling: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, Arhenius 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; bumer 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 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: 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-parameteric mapping, numerical integration.	8
Module –V Generate shape function and natural coordinates; solving finite element problems using code/software.	8

TEXT BOOKS:

T1. S.S. Rao, *The Finite Element Method in Engineering*, 5th Ed., Butterworth-Heinemann, 2012.

T2. T.R. Chandrupatla, A.D. Belegundu, *Introduction to Finite Elements in Engineering*, 3rd Ed., PHI Learning Pvt. Ltd, 2002.

T3. 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:

R1. 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 Colburnsanologies.	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
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,Arhenius 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; bumer 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:

3. An Introduction to Combustion, concepts and applications by S. R.Turns, McGraw Hill (2000).
4. 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-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 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 (NOx, CO) of Diesel Engine.
8. Analysis of Exhaust emission (NOx, 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.

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, Arhenius 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; bumer 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: ME 369 (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 Poropulsion, 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 Happian-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 Incoporated.

COURSE INFORMATION SHEET

Course code: ME 308
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.

SEVENTH SEMESTER

COURSE INFORMATION SHEET

Course code: ME 413
Course title: Professional Practice, Law & Ethics
Credits: 2 L:2 T:0 P:0
Class schedule per week: 2
Class: B. Tech
Semester / Level: VII / Fourth
Branch: Mechanical Engineering

SYLLABUS

Module	Hours
Module -I School of ethics and human values: Profession and ethics, professional ethics, branches of ethics, Utilitarianism, duty ethics, virtue ethics, case studies, virtues for engineers, Introduction to human values, values in engineering profession,	5
Module –II Ethical standards and occupational ethics: Occupational safety and health, occupational safety and health in various countries, mechanical machinery hazards, Factories act, trade unions, trade dispute act, workmen's compensation act, payment of wages act, International Labor Law	6
Module – III **E**thical decision making: Introduction to ethical dilemma, naïve decision making, elements of ethical dilemma, conflicts of interest, responsible organizational disobedience, confidentiality and proprietary information, whistle blowing, gifts and bribes, plagiarism, intellectual property, crime and punishment, individual unethical practices.	6
Module - IV Engineering ethics and sustainability: Responsibility of an engineer, influence and power, authority, delegation, professional rights, values and environment, ethical dimensions of environmentalism, tragedy of commons, ethics and sustainability.	4
Module –V Ethical codes of conduct: Introduction to codes of conduct, professional codes, evolution of codes, values in codes, limitations of codes of conduct, ECI code of ethics for engineers, NSPE code of ethics for engineers	4

Text books:

1. M Govindrajan, Engineering Ethics, Prentice Hall Publications (2004)
2. IA Dhotre, VS Bagad, Professional Ethics in Engineering, Technical Publications

Reference books:

1. Charles E Harris, Engineering Ethics: Concept and Cases, Wadsworth publication, Fourth Edition]
2. R.S. Nagarazan, A Textbook on Professional Ethics and Human Values, New Age Publication (2006)

COURSE INFORMATION SHEET

Course code: ME 401
Course title: Refrigeration and Air conditioning
Credits: 3 **(**L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B. Tech.
Semester / Level: 7
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction about Refrigeration- Definition of various terms, Method of refrigeration, Air refrigeration system, Bell-Coleman cycle, Introduction about Air craft Air-conditioning, Evaporative cooling system, Boot strap cooling system, Regenerative cooling system, Reduced ambient system.	8
Module –II Analysis of vapour compression cycle, Modifications to basic cycle, Multi pressure system, Multi-evaporator system and Cascade system, properties of refrigeration, Selection of refrigeration, Discussion of components of VC system, Servicing, Vacuumizing and charging of refrigerant, Electrical and electronics control of air conditioning system and its fault detection.	8
Module – III Vapour Absorption Refrigeration system and its applications, Thermo-electric Refrigeration system, Steam jet Refrigeration system, magnetic refrigeration, vortex and pulse tube refrigeration system.	8
Module - IV Psychrometry- Definition for properties, Introduction to cooling load calculations, Comfort conditions, Effective temperature concept, properties of moist Air-Gibbs Dalton law, Specific humidity, Relative humidity, Enthalpy, Psychometric of Air-conditioning Process, Mixing of air stream.	8
Module –V Air-conditioning system- Discuss about the central plant with direct evaporator and chiller applications, ice plant, Refrigerators, Food preservation, IQF technique freeze drying and Cold storage.	8

Text book:

1. Arora, C.P., Refrigeration and Air Conditioning, 3nd ed., Tata McGraw-Hill, 2010.

Reference books:

1. Stoecker, W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.
2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.
3. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.
4. Jones W.P., "Air conditioning engineering." 5th edition, Elsevier Butterworth-Heinemann,2001.

COURSE INFORMATION SHEET

Course code: ME 403
Course title: Hydraulic and Pneumatic Control
Credits: 3 **(**L: 3, T: 0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to hydraulic and pneumatic systems, advantages and limitations, general layout of components. ISO symbols. Standard tubing sizes. Types of hydraulic fluids and its properties. Governing laws, Power, energy and flow rate calculations. Basic types and constructions of hydraulic pumps and actuators.	8
Module –II Distribution system, Sizing and flow rate requirements, Connectors and couplings. Basics of hydraulic flow in pipes, Hydraulic circuit analysis, flow and pressure measurement, losses due to friction. Control components in hydraulic systems, pressure, flow, direction control valves, Servo valves, Fuses, shock absorbers, and switches.	8
Module – III Hydraulic circuit design and analysis, Single and double acting cylinder operation, regenerative circuit, pump unloading circuit, double pump hydraulic system, automatic cylinder sequencing, synchronizing and reciprocating circuit, speed control, braking, transmission systems, Mechanical and Hydraulic servo system.	8
Module - IV Air preparation and components, Properties of air, Gas laws, Compressors, Conditioners, control valves, pneumatic actuators, vacuum systems, and accumulators. Pneumatic circuit design and analysis, energy losses. Electro pneumatics: control of cylinders using pressure and limit switches, reciprocating, sequencing, sorting and regenerative circuits. Counting, timing and servo systems.	8
Module –V Programmable Logic Controllers, Introduction to Boolean algebra, Fluidic devices: Sensors, and control of fluid power systems, Nozzle flapper systems, stroke reading cylinders, Moving Part Logic (MPL) control systems, safety, maintenance and troubleshooting of hydraulic and pneumatic systems, filters, strainers, regulators, lubricators, reservoir, problems caused due to contamination and wear, air trapping, and temperature.	8

TEXT BOOKS:

1. Anthony Esposito, Fluid Power with applications, Pearson Education, 1997.
2. John Watton, Fundamental of Fluid power control, Cambridge University press, 2009.
3. Fluid Power Engineering, M GalalRabie, McGraw Hill, 2009.

REFERENCE BOOKS:

1. Andrew Parr, Hydraulics and Pneumatics, A Technician's and Engineer's Guide, Butterworth-Heinemann, 2011
2. IlangoSivaraman, Introduction to Hydraulics and Pneumatics, PHI Learning Pvt. Ltd., 2017. Sundaram K. Shanmuga, Hydraulic and Pneumatic Controls, S. Chand, 2006.
3. Majumdar, S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw Hill, 2001
4. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2007.
5. Srinivasan. R, "Hydraulic and Pneumatic Control", IInd Edition, Tata McGraw - Hill Education

COURSE INFORMATION SHEET

Course code: ME 409
Course title: Industrial Management
Credits: 3 **(**L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module –I Introduction to Industrial management, Brief history of industries in India, Brief definition of management, organization and administration, characteristics of management, functions of management , Principles of management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization, Forms of ownerships, concept of Globalization.	8
Module –II Strategic importance of HRM, Objectives of HRM, challenges to HR professionals, Role, Responsibilities and competencies of HR professionals, HR department operations, Human Resource Planning - objectives and process, human resource information system. Talent acquisition, recruitment and selection strategies, career planning and management, training and development, investment in training program, executive development.	9
Module – III Materials Management- Objectives, Inventory – functions, types, associated costs, inventory classification techniques. Stores Management and Stores Records. Purchase management, duties of purchase manager, associated forms. Concepts of production system, Production planning and control, Work and time study, Plant location, Factors affecting the plant location, comparison of rural and urban sites, methods for selection of plant. Plant Layout – Objectives, types of production, types of plant layout – various data analyzing forms-travel chart. Material handling, Job decision & project management using PERT & CPM, Inspection and Quality control, forecasting and line balancing.	8
Module – IV Capital Structure, Fixed & working capital, Role of Securities and Exchange Board of India (SEBI), function of money market and capital Market, sources of finance. Introduction to capital budgeting, Techniques of capital budgeting. Break even analysis - assumptions, importance, Cost-Benefit analysis, CVP graph, Project Management, Project network analysis, CPM, PERT and Project crashing and resource Leveling.	8
Module –V Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, Quality Management Assistance Tools:	9

Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing).Quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004. Environmental Management System Standard- ISO 27001:2005 Information Security Management System.	

Text Books:

1. O. P. Khanna, Industrial Engineering and Management, Dhanpatrai publications.
2. L.C.Jhamb, SavitriJhamb, Industrial Management – I, Everest Publishing House.
3. Buffa E.S, Modern Production and Operational Management, John Wiley & Sons.

Reference Books:

1. Production, Planning and Inventory Control by S.L.Narasimhan, D.W.McLeavey, P.J.Billington, Prentice Hall.
2. Production Systems: Planning, Analysis and Control by J.L.Riggs, Wiley.
3. Production,Operations Management by Panneerselvam. R. , Prentice Hall of India Pvt Ltd.
4. Operation Managenment by Nigel Slack, Stuart Chambers, Robert Johnston,Pearson Education.

COURSE INFORMATION SHEET

Course code: ME 411
Course title: Computer Aided Design
Credits: 3 **(**L: 3, T:0, P: 0)
Class schedule per week: 3
Class: B.Tech
Semester / Level: 7
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to CAD; Product life cycle; Input/output devices; Different Coordinate systems; Basic features available in CAD systems; 3D Modeling and viewing; Modeling aids and tools offered by CAD systems: Layers, Groups, Grids, Entity selection methods, Geometric arrays, offsetting, Entity editing.	8
Module –II Representation of lines, curves; Line and Curve generation algorithm: DDA, Bresenham's algorithms; Analytic Curves; Synthetic Curves: Concept of continuity, cubic spline curve, Bezier curve, B-Spline curve and NURBS.	8
Module – III Representation of surface patches; Analytic surfaces; Synthetic surfaces; Surface modelling; Solid entities; CSG approach of solid modelling; Boolean operations; B-rep approach of Solid Modelling; Boundary evaluation technique.	8
Module - IV Geometric Transformations; Translation, Scaling, Reflection, Rotation, Mappings of Geometric Models; Projections; Introduction to assembly modeling, IGES, STEP & DXF data exchange format	8
Module –V Industrial applications involving assembly, position, kinematic and dynamic analysis of a mechanism. Interference analysis in motion, CAD/CAE software tools, Project on mechanical systems design and analysis.	8

TEXT BOOKS:

1. Mastering CAD/CAM by Ibrahim Zeid, Tata McGraw-Hill
2. Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A.D. Belegundu

REFERENCE BOOKS:

1. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw-Hill
2. A First Course in Finite Element Method, D.L. Logan, Cengage Learning

COURSE INFORMATION SHEET

Course code: ME 397(OPEN ELECTIVE - IV)
Course title: Industrial Robotics and Automation
Credits: 3 L:3, T:0, P:0
Class schedule per week: **03**
Class: **B. Tech**
Semester / Level: **7th/Level-4**
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I **IIndustrial robot anatomy:** Robot classification and its application in industry, Robot subsystems,Serial and Parallel robot, Links and Joints, Degrees of Freedom (DoF),Position and orientation of a rigid body, Co-ordinate transformation, Homogeneous transformation, Denavit and Hartenberg (DH) Parameters, Introduction to Forward and Inverse kinematics of serial robot.	9
Module –II **Actuators and Sensors:** Joint actuating system, transmission, servomotors, power amplifiers, power supplies. Actuators, Electric and hydraulic drives, Sensors: Position, Velocity, Force, Range, and Vision sensors. **Robot Workspace:** Workspace of manipulator, Type of workspaces, Workspace of a two link serial manipulator.	8
Module – III Velocity analysis: The Jacobian matrix, Link velocities, Jacobian computation, Acceleration analysis, Role of Jacobian in statics, Singularities. **Trajectory planning**: Cartesian and Joint space trajectories, Cubic, Quintic polynomial.	8
Module - IV Controls Theory: Different control techniques, Transfer Function, State space representation, Proportional control, Integral control, Proportional plus Derivative control, PID control, Properties of dynamic model, effect of friction, actuator's rotor inertia, Joint controllers.	8
Module –V Industrial automation applications, Robot cell design and control, Methods of programming: Robot languages, Lead-through programming, Point-to-point and motion interpolation. Performance analysis of Industrial robots. Economic, Social and Safety aspects in automated industrial environment.	8

TEXT BOOKS:

1. S. K.Saha, Introduction To Robotics,Tata McGraw-Hill Education, 204.
2. M. P. Groover, M. Weiss, R. N. Nagel, N. G. Odery, A. Dutta, Industrial Robotics, McGraw Hill Education, 2015.
3. John J. Craig, Introduction to robotics mechanics and control, Pearson Education India, 2009.
4. S.B. Niku, Introduction to robotics: analysis, control, applications. John Wiley & Sons 2020.

REFERENCE BOOKS:

1. R. K. Mittal, I. J. Nagrath, Robotics and Control, McGraw Hill Education, 2016
2. M. W. Spong, M. Vidyasagar, Robot Dynamics and Control, Wiley Student Edition, 2013.

COURSE INFORMATION SHEET

Course code: ME 389(OPEN ELECTIVE - IV)
Course title: Mechatronics & its Applications
Credits: 3 L:3, T: 0, P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level: **7th/Level-4**
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module: 1 Introduction Definition of Mechatronics, Mechatronics in manufacturing products and design, Review of fundamentals of electronics, Gates and K map Minimization ,JK Flip Flop ,Static and Dynamic Characteristics, Block Diagram, Simulation and Modeling	8
Module –II Signal Conditioning Data Conversion Devices, Sensors and transducers, Displacement, Pressure, Piezoelectric, Temperature, Optical, Fluid Microsensors, Signal processing Devices, Relays, Comparators, Filters, Timers, Transfer Systems , Converters, Amplifiers and its types , AC and DC amplifiers ,PLC's programming.	8
Module – III Microprocessors , Controllers and Drives Microprocessors, Mcrocontrollers, Drives, Linear motion bearings, cams and ball screws, PID controllers, Closed Loop and Open loop control systems.	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, Error Detectors.	8

Text book:

3. Introduction to Mechatronics and Measurement System by David G. Alciatore, Michael B. Histamd, Mc Graw Hill
4. Mechatronics by Bolton, Pearson Education

Reference books:

1. Mechatronics System Design by Devdas and Shetty, Pearson Education
2. CNC TECHNOLOGIES BY HMT LTD MGH
3. Mechanical Measurements and Instrumentation, By Er. R.K.Rajput,Kajaria 2017.

COURSE INFORMATION SHEET

Course code: MT 204
Course title: Constitution Of India
Credits: NC **(**L: 2, T:0, P: 0)
Class schedule per week: 2
Class: B. Tech.
Semester / Level: 7
Branch: Mechanical Engineering

Syllabus

Module	Hours
Module -I Introduction to the Constitution of India, Salient Features of the Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy	5
Module –II Union and State Executives: President and Prime Minister, Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Governor: Role and Position, Chief Ministers and Council of ministers.	5
Module – III The Indian Judicial System – The Supreme Court and The High Court's – composition, Jurisdiction and functions, The Role of the Judiciary.	5
Module - IV Local Government- District's Administration: Role and Importance, The Panchayatas – Gram Sabha, Constitution and Composition of Panchayats, Constitution and Composition of Municipalities	5
Module –V Miscellaneous- Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.	5

Books recommended:

1. The Constitution of India by "Ministry of Law India" Kindle Edition
2. Constitutional History of India by Prof.M.V.PYLEE-S.Chand Publishing
3. Indian Administration by Avasti and Avasti-Lakshmi Narain Agarwal Educational Publishers.2017 edition.
4. Introduction to the Constitution of India by D D Basu by Lexis Nexis : 20th edition.
5. Constitution of India V.N.Shukla's EBC Explorer Edition 13th ,2017

COURSE INFORMATION SHEET

Course code: ME 404
Course title: Refrigeration and air conditioning lab
Credits: 1.5 **(**L: 0, T: 0, P:3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7
Branch: Mechanical Engineering

List of experiments:

1. Comparative study of vapour compression system and vapour absorption system
2. To evaluate the coefficient of performance of vapour absorption system with load and without load
3. To evaluate the coefficient of performance of vapour absorption system with different heating system (gas and electricity) and comparative energy analysis.
4. To evaluate coefficient of performance of thermoelectric cooler
5. Performance study of cooling using peltier effect by varying flow rate of water in cooling and heating side .
6. Performance evaluation of vapour compression test rig
7. Performance evaluation of variable load refrigeration test rig
8. Performance evaluation of variable load refrigeration system by varies flow rate through expansion valve/capillary
9. Measurement of relative humidity using psychometre.
10. Study of the effect of the flow rate of fan in room humidity
11. Study of electrical and electronics connection of air conditioning system and fault detection .
12. Study of prospect of solar energy in refrigeration and air conditioning industry.

COURSE INFORMATION SHEET

Course code: ME 406
Course title: Computer Aided Design and Drafting Lab
Credits: 1.5 **(**L:0, T: 0, P:3)
Class schedule per week: 3
Class: B. Tech
Semester / Level: 7
Branch: Mechanical Engineering

List of experiments:

1. Understanding of Auto CAD.
2. Practice of command in auto cad like units, limits, grid, line, pline, donut, polygon, chamfer, fillet, offset, text, detext.
3. Draw the part drawing in auto cad without dimensioning using different commands.
4. Draw the dimensional complex geometry like stuffing box using commands in auto cad.
5. Understanding of CREO.
6. Draw the 3D drawing using CREO of different components and show its plan, elevation and side view.
7. Draw the parts and assembly drawing of foot step bearing and steering wheel.
8. Draw the parts and assembly drawing of clutch plate and knuckle joint.
9. Understanding of ANSYS and create the solid models.
10. Determination of deflection and stresses in 2D and 3D trusses.
11. Determination of deflection and stresses in different beams at different conditions.
12. Steady state heat analysis of plane and axi-symmetric components.

EIGHT SEMESTER

ME 400: Research Project/ Industry Internship

Credit: 10