SYLLABUS OF
BACHELOR OF TECHNOLOGY
(MECHANICAL ENGINEERING)

Effective from
Session 2020-2021

Department of Mechanical Engineering
Faculty of Engineering and Technology
Jamia Millia Islamia, New Delhi, INDIA

Contents

VISION and MISSION of the Department of Mechanical Engineering, Faculty of Engineering &Technology

Jamia Millia Islamia, New Delhi 110025

Vision:

To Establish the Department as a hub of quality education, research with innovation and recognition at National and International level.

Mission:

1. To transfer the knowledge through quality education which can develop skills, inculcate values and improve research with innovative methods.
2. To re-engineer the engineering education and to create leadership qualities with futuristic vision.
3. To produce young engineers who can be useful in New Technological Design, areas of Environment, space and sustainable technologies.
4. To develop Teaching-Learning methods which can produce socially committed good professional human being who can contribute effectively in Nation building and represent Country Internationally.

Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Program Specific Outcomes (PSOs)

The Department of Mechanical Engineering in consultation with various stakeholders have formulated the Programme Educational Objectives (PEO's) that are broad statements that describe the career and professional accomplishments that the program is preparing its graduates to achieve in few years, subsequent to receiving the degree. The PEO's of the B. Tech. programme in Mechanical Engineering are as follows:

Program Educational Objectives (PEOs)

1. The graduates will be well prepared for successful careers in industry/ consultancy/research & development/teaching/allied areas and will be academically prepared to lead organizations they join or start related to the subjects of mechanical engineering.
2. The graduates will engage in professional and extension activities in the field of mechanical engineering and its allied areas and contribute to the profession and society at large by pushing the frontiers in technology.
3. The graduates will be successful in higher education in mechanical and allied areas and in management, if pursued, leading to masters and research programs
4. The graduates will be, through this academic programme groomed as professional engineers enabling them to contribute effectively to the growth and development of the knowledge body.

Programme Outcomes are attributes of the graduates from the programme that are indicative of the graduates' ability and competence to work as an engineering professional upon graduation. Program Outcomes are statements that describe what students are expected to know or do by the time of graduation, they must relate to knowledge and skills that the students acquire from the programme. The achievement of all outcomes indicates that the student is well prepared to achieve the program educational objectives down the road. The department of Mechanical engineering has following twelve PO's. The course syllabi and the overall curriculum are designed to achieve these outcomes:

Programme Outcomes (POs)

1. **Engineering Knowledge:** Apply the knowledge of Mathematics, Science and Engineering Fundamentals, and an engineering specialization to solution of complex engineering problems.
2. **Problem formulation and Analysis:** Identify, formulate, research literature, and analyze engineering problems so that substantiated conclusions can be reached using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/ development of solutions:** Design of solution for engineering problems and identify/design of system components or processes that meet the specified needs with

appropriate considerations of public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigation of Complex problems:** Use of research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling related engineering activities with an understanding of limitations.
6. **Engineer and Society**: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and assume responsibilities of a professional engineering practitioner.
7. **Environment awareness and responsibility:** Understanding the impact of the professional engineering solutions in the environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.
8. **Ethical behavior:**Apply ethical principle and show commitment towards professional ethics and responsibilities and norms of engineering practice.
9. **Individual and team work:** Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on different engineering activities with the engineering community and with society at large such as being able to comprehend and write effective report and design documentation, make effective oral presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects 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 new development. Can take masters and research program in the area and allied areas.

Program Specific Outcomes (PSOs)

PSO1: Shall have acquired the ability of entrepreneurship to start an industry based on mechanical engineering in the areas of production, manufacturing and allied areas.

PSO2: After graduation the graduate shall have gained the experience to be attracted toward design and consultancy.

PSO3: Shall have gained the knowledge to pursue higher level of understanding by way of research in relevant areas of mechanical engineering.

PSO4: Shall have gained the knowledge base to enable employment in infrastructure development.

Course Structure of B. Tech. (Mechanical) as per AICTE Norms

MECHANICAL ENGINEERING DEPARTMENT, Faculty of Engineering & Technology, *Jamia Millia Islamia*

B.TECH. I SEMESTER (Common to all branches)

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	AS-101	Communication Skills	Theory	HS	3	3	0	0	3
2	AS-102	Engineering Physics – I	Theory	BS	3	2	1	0	3
3	AS-103	Engineering Chemistry – I	Theory	BS	3	2	1	0	3
4	AS-104	Engineering Mathematics - I	Theory	BS (CBCS)	4	3	1	0	4
5	ME-101	Basics of Mechanical Engineering	Theory	ES	3	3	0	0	3
6	CE-101	Basics of Civil Engineering	Theory	ES	3	2	1	0	3
7	EE-101	Basics of Electrical Engineering	Theory	ES	3	2	1	0	3
i	AS-151	Language Lab	Lab	HS	1	0	0	2	2
ii	AS-152	Engineering Physics LAB – I	Lab	BS	1	0	0	2	2
iii	AS-153	Engineering Chemistry LAB – I	Lab	BS	1	0	0	2	2
iv	ME-102	EM(Engineering Mechanics) Lab	Lab	ES	1	0	0	2	2
v	ME-151	Workshop Practice	Lab	ES	2	0	0	4	4
				Total	28	17	5	12	34

B.TECH. II SEMESTER (Common to all branches)

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE		Credits	L	T	P	HRS
1	AS-201	Human Resource Management (HRM)	Theory	HS	3	3	0	0	3
2	AS-102	Engineering Physics – I	Theory	BS	3	2	1	0	3
3	AS-103	Engineering Chemistry – I	Theory	BS	3	2	1	0	3
4	AS-104	Engineering Mathematics - I	Theory	BS	4	3	1	0	4
5	AS-105	Innovative Technology & Bio-Sciences	Theory	BS (CBCS)	4	3	1	0	4
6	EC-101	Basic of Electronics & Comm. Engineering	Theory	ES	3	3	0	0	3
7	CS-201	Fundamentals of Computing	Theory	ES	3	2	1	0	3
i	AS - 152	Engineering Physics LAB – I	Lab	BS	1	0	0	2	2
ii	AS - 153	Engineering Chemistry LAB – I	Lab	BS	1	0	0	2	2
iii	ME-250	Engineering Graphics Lab	Lab	BS	2	0	0	4	4
				Total	27	18	5	8	31

Course Structure of B. Tech. (Mechanical) as per AICTE Norms

MECHANICAL ENGINEERING DEPARTMENT, Faculty of Engineering & Technology, *Jamia Millia Islamia*

B.TECH. (MECHANICAL ENGG.) III SEMESTER w.e.f. academic session 2020-21

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-301	Mechanics of Solids	ES	4	3	1	0	4
2	ME-302	Manufacturing Processes	PC	3	2	1	0	3
3	ME-303	Applied Thermodynamics	ES	3	2	1	0	3
4	ME-304	Material Science	ES (CBCS)	4	3	1	0	4
5	ME-307	Instrumentation, Measurement & Control	PC	3	2	1	0	3
6	ME-306	Fluid Mechanics-I	ES	3	2	1	0	3
7	AS-301	Engineering Mathematics III	BS	4	3	1	0	4
i	ME-331	Applied Thermodynamics Laboratory	PC Lab	1	0	0	2	2
ii	ME-335	Instrumentation, Measurement & Control Laboratory	PC Lab	1	0	0	2	2
iii	ME-336	Material Science and Mechanics of Solids Laboratory	PC Lab	1	0	0	2	2
iv	ME-334	Manufacturing Processes Laboratory	PC Lab	1	0	0	2	2
			Total	28	17	7	8	32

B.TECH. (MECHANICAL ENGG.) IV SEMESTER

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-401	Heat and Mass Transfer	PC	3	2	1	0	3
2	ME-402	Production Engineering-I	PC	4	3	1	0	4
3	ME-403	CAD and FEM	PC (CBCS)	4	3	1	0	4
4	ME-404	Engineering Economy	PC	3	2	1	0	3
5	ME-405	Kinematics of Machines	PC	3	2	1	0	3
6	AS-401	Numeric and Scientific Computing	BS	4	3	1	0	4
7	EE-401	Electromechanical Energy Conversion	ES	2	2	0	0	2
i	ME-431	Heat & Mass Transfer Laboratory	PC Lab	1	0	0	2	2
ii	ME-432	Production Engineering Laboratory	PC Lab	1	0	0	2	2
iii	ME-433	CAD, FEM and Computer aided Machine Drawing Laboratory	PC Lab	2	0	0	4	4
iv	ME-434	Kinematics of Machines Laboratory	PC Lab	1	0	0	2	2
v	AS-431	Numeric and Scientific Computing Laboratory	BS Lab	1	0	0	2	2
			Total	29	17	6	12	35

B.TECH. (MECHANICAL ENGG.) V- SEMESTER w.e.f. academic session 2020-21

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-501	Fluid Mechanics-II	PC	3	2	1	0	3
2	ME-502	Design of Mechanical components	PC	3	2	1	0	3
3	ME-507	Mechatronics	CBCS	4	3	1	0	4
4	ME-504	Production Engineering-II	PC	3	2	1	0	3
5	ME-505	Dynamics of Machines	PC	3	2	1	0	3
6	ME-506	Internal Combustion Engines	PC	3	2	1	0	3
i	ME-531	Fluid Mechanics Laboratory	PC Lab	1	0	0	2	2
ii	ME-532	Design of Mechanical Components Laboratory	PC Lab	1	0	0	2	2
iii	ME-533	Dynamics of Machines Laboratory	PC Lab	1	0	0	2	2
iv	ME-535	Mechatronics Laboratory	PC Lab	1	0	0	2	2
			total	23	13	6	8	27

B.TECH. (MECHANICAL ENGG.) VI- SEMESTER

S. No.	COURSE NO.	COURSE & NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-601	Computer Aided Manufacturing	PC	3	2	1	0	3
2	ME-602	Design of Mechanical System	PC	3	2	1	0	3
3	ME-603	Operations Research	CBCS	4	3	1	0	4
4	ME-604	Refrigeration and Air conditioning	PC	3	2	1	0	3
5	ME-605	Turbo Machines	PC	3	2	1	0	3
i	ME-631	Computer Aided Manufacturing Laboratory	PC Lab	1	0	0	2	2
ii	ME-632	Refrigeration and Air Conditioning Laboratory	PC Lab	1	0	0	2	2
iii	ME-633	Design of Mechanical Systems Practice Laboratory	PC Lab	1	0	0	2	2
iv	ME-634	Turbo machines Laboratory	PC Lab	1	0	0	2	2
v	ME-635	Industrial Training (six weeks in summer/winter vacations) (Audit Course)	Audit					
			total	20	11	5	8	24

B.TECH. (MECHANICAL ENGG.) VII- SEMESTER

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-701	Mechanical Vibrations	PC	3	2	1	0	3
2	ME-702	Industrial Engineering	PC	3	2	1	0	3
3	ME-703	Automobile Engineering	PC	3	2	1	0	3
4	ME-704*	PROGRAM ELECTIVE I (THERMAL& FLUID) (Separate list of elective courses attached)	PE	3	2	1	0	3
i	ME-731	Automobile Engineering and IC Engine Laboratory	PC Lab	1	0	0	2	2
ii	ME-732	Industrial Engineering Laboratory	PC Lab	1	0	0	2	2
iii	ME-733	Mechanical vibrations Laboratory	PC Lab	1	0	0	2	2
iv	ME-734	Solar Energy Laboratory	PC Lab	1	0	0	2	2
v	ME-735	Project-I	Project work	5	0	0	10	10
			total	21	8	4	18	30

B.TECH. (MECHANICAL ENGG.) VIII- SEMESTER

S. No.	COURSE NO.	COURSE NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-801	PROGRAM ELECTIVE II (MACHINE DESIGN) (Separate list of elective courses attached)	PE	3	2	1	0	3
2	ME-830	PROGRAM ELECTIVE III (PRODUCTION& INDUSTRIAL) (Separate list of elective courses attached)	PE	3	2	1	0	3
3	ME-814	Product Design	PE (CBCS)	4	3	1	0	4
4	ME-850	Special Topic (Optional Audit course)	Optional Audit course	0	3	0	0	3
i	ME-851	Seminar on Industrial Training (Compulsory Audit Course)	Seminar	0	0	0	2	2
ii	ME-852	Project-II	Project work	10	0	0	20	20
			total	20	10	3	22	35

Program Electives								
S. No.	COURSE NO.	COURSE NAME	COURSE TYPE	Credit	L	T	P	HRS
1	ME-801	Robotics	PROGRAM ELECTIVE II (MACHINE DESIGN)	3	2	1	0	3
2	ME-802	Engineering System DesignOptimization						
3	ME-803	Vehicle Dynamics						
4	ME-804	Modal Analysis						
5	ME-805	Introduction to Human Body Mechanics						
6	ME-806	Innovative Product Design						
7	ME-807	Fracture Mechanics						
8	ME-808	Composite Materials						
9	ME-809	Engineering Tribology						
10	ME-810	Simulation of Mechanical Systems						
11	ME-811	Artificial Intelligence and Robotics						
12	ME-812	Machinery Fault Diagnostics &Signal Processing						
13	ME-813	Applied Elasticity and Plasticity						
1	ME-704	Energy Sources	PROGRAM ELECTIVE I (THERMAL & FLUID)	3	2	1	0	3
2	ME-705	Environmental Pollution and Abatement						
3	ME-706	Theory of Combustion and Emission						
4	ME-707	Nuclear Power Generation and Supply						
5	ME-708	Computational Fluid Dynamics						
6	ME-709	Gas Dynamics						
7	ME-710	Fuels and Combustion						
8	ME-711	Cryogenics						
9	ME-712	Design of Pump, Blowers and Fans						
10	ME-713	Fluid Controls						
11	ME-714	Design of Heat Exchanger Equipment						
12	ME-715	Non-Conventional Energy Sources						
13	ME-716	Environmental Engineering						
1	ME-830	Ergonomics	ELECTIVE III (PRODUCTION& INDUSTRIAL)	3	2	1	0	3
2	ME-831	Welding Technology						
3	ME-832	Supply Chain Management-Planning						
4	ME-833	Quality Assurance and Reliability						
5	ME-834	Non-Destructive Evaluation & Testing						
6	ME-835	Technology of Surface Coating						
7	ME-836	Quantity Production Methods						
8	ME-837	Engineering Risk–Benefit Analysis						
9	ME-838	Infrastructure Systems Planning						
10	ME-839	Managing Innovation and Entrepreneurship						
11	ME-840	Global Strategy and Technology						
12	ME-841	Knowledge Management						
13	ME-842	Mechanical Handling Systems &Equipment						
14	ME-843	Maintenance Management						
15	ME-844	Supportability and Life cycle analysis						

Course Syllabi

B.Tech.(Mechanical Engineering)

FIRST & SECOND Semester

COMMUNICATION SKILLS

Paper Code	**AS-101**
Course Credits	**3**
No. of Lectures / week	3
No. of Tutorials/week	0

Course Description

Unit – I

The Art of Communication: English Communication, Technical, Verbal & Non-Verbal Communication, Barriers in Communication, The Art of Communication; Reading, Writing, Listening, Speaking and Strategies to overcome challenges in effective communication.

Unit – II

Fundamentals of English Syntax**:** Basics of Parts of Speech, Determiners, Use of tenses, Transformation of sentences Active-Passive; Direct-Indirect; Simple-Compound-Complex sentences, Use of Prepositions, Discourse Markers, Subject Verb Concord, Use of Conjunctions, Use of Verbs.

Unit – III

Writing: Formal & informal letters, unmade communication and Demand Communication Note Making, Report writing, Book Reviews, Abstracts and Research Proposals, creative writing, Email correspondences, Résumé writing, Executive summery.

Unit – IV

Word Vocabulary & Phonetics: Word formation, foreign roots (Etymology), Suffix, Prefix, Antonyms, Synonyms, Homonyms, one-word substitution, Idioms and Phrases, Acronyms, IPA Symbols, Vowels and Consonants, Place and Manner of Articulations, Phonetic transcription and Accentuation (theoretical insight).

Unit – V

Literature Poetry:
Where the Mind is Without Fear- Rabindranath Tagore
The Express- Stephan Spender
Amalkanti- Nirendranath Chkrabarti
Road Not taken- Robert Frost
Prose:
Of Studies- Francis Bacon,
Vanishing Animals- Gerald Durrell
Fitin: Old man and the Sea – E Hemmingnoy
The Child- Munshi Premchand
Soapnut Leaves- Chaaso

Text books:	• *The Joy of Reading*: Orient Blackswan Pvt. Ltd, New Delhi • *Fluency in English:* Macmillan Publishers, New Delhi • Intermediate Grammar Usage and Composition: M.L.Tikoo and Subramanian , Orient Blackswan Pvt. Ltd, New Delhi • A Text Book of English Phonetics for Indian Students: T. Balasubramanian, Macmillan Publishers, New Delhi. • Practical English Usage: Michael Swan, Oxford University Press.
Reference books:	• The Oxford Guide to effective Writing and Speaking Skills: John Seely, Oxford University Press. • English Pronouncing Dictionary: Daniel Jones, Cambridge University Press. • Technical communication Principles and Practice: Meenakshi Raman and Sangeeta Sharma, Oxford.

Course Outcomes	CO1: Developing the concepts of communication skills/soft skills CO2: Developing the syntactical concepts of grammer CO3: Command over professional/technical writing skills CO4: Developing a sense interpretation through literature and its social/political and ethical aspect CO5: Proficiency in language handling/delivery through English photenics and accent mechanism

ENGINEERING PHYSICS – I

Paper Code	**AS-102**
Course Credits	**3**
No. of Lectures / week	2
No. of Tutorials/week	1

Course Description

Unit – I

Physics of Motion: Inertial and non-inertial frames, conservation principles of momentum and energy; many particle systems, rocket motion, simple harmonic motion, damped harmonic motion.

Unit – II

Optics: Two views about nature of light, concept of coherence, interference of light, single slit and N-slits diffraction, hydrogen atom spectrum, diffraction grating and spectral resolution.

Unit – III

Electromagnetism: Cylindrical coordinates Gradient, divergence and curl, line integral, surface integral and volume integral, Lorentz force, Gauss's law, Ampere's Law, Maxwell's equations, electromagnetic waves and Ponting vector.

Unit – IV

Quantum Ideas: Difficulties of classical Physics, Planck hypothesis, wave particle duality, photoelectric effect, Compton effect, uncertainty principle and its implications, wave packets, group velocity and phase velocity, Davisson Germer experiment.

Unit – V

Physics of Materials: Classifications of materials, crystal structure, unit cell and lattice parameters, Miller indices, Bragg's law and X-ray diffraction, classical free electron theory, its success and failures, Wiedemann Franz law, Maxwell Boltzmann distribution.

Reference /Text books:

- Halliday, Resnick Physics
- Jenkins, White Optics
- Wahab Solid State Physics
- G. Gamow Physics, Foundations and frontiers
- Mathews Optics
- Islam S.S. Solid State Physics

Course Outcomes

CO1: Enhancing the concepts of conservative and nonconservative forces
CO2: Understanding the basics of optics and introduction to lasers including their applications in field
CO3: Expanding the concepts of electromagnetism and its various applications
CO4: Exploring the basics of quantum ideas: photoelectric effect, Compton effect, Planck's hypothesis etc.
CO5: Understanding the physics of solids

ENGINEERING CHEMISTRY – I

Paper Code	**AS-103**
Course Credits	**3**
No. of Lectures / week	2
No. of Tutorials/week	1

Course Description

Unit – I

Chemical And Instrumental Methods of Analysis: Gravimetric Analysis; Digestion and its Importance, Favourable Conditions for Precipitation, Volumetric Methods of Analysis; Expression of concentration of solutions Acid-Base (pH metry and conductometry), Redox, Precipitation and Complex Metric Titrations. Chromatography; Definition and Different Types of Chromatography, Fundamentals of Spectroscopy; Principles and Applications of UV-Visible, Infra-Red and Atomic Absorption Spectrometry.

Unit – II

Electrochemistry and Surfactants: Electrolytic and Galvanic cell, Electrode Potential, Standard Electrode Potential, EMF series, Nernst Equation, Cell emf Measurement, Reversible and Irreversible cell, Thermodynamic Overview of Electrochemical Processes, Conductance, Cell Constant and its Determination. Surface Active Agents, Soaps, Types and Advantages of Detergents, Critical Miceller Concentration, Hydrophilic and Hydrophobic Interactions, HLB values, Fricoohesity of Surfactant Solutions.

Unit – III

Molecular Structure and Phase Rule: Valence Bond Theory, Molecular Orbital Theory, Molecular Orbital of Polyatomic Molecules, Molecular orbital Theory of Solids crystal structure, Semiconductors and Superconductors. Phase Rule; Phase Rule Applications to One and Multiple Component systems, Fe-C Phase Equilibrium Diagram, Types of Alloys, Ferrous and Nonferrous Alloys.

Unit – IV

Polymers and Composites**:** Basics of polymer chemistry, Molecular weight, Glass transition temperature and Melting point, Methods of polymerization, Structure property relationship, Thermoplastics and Thermosets, Fabrication of polymers-Compression, Injection, Extrusion, Moulding. Synthesis, Properties and uses of polyethylene, Polyvinyl Chloride, Ploy Methyl Methacrylate, Urea formaldehyde resin and Melamine formaldehyde resin, Elastomers, Conducting polymers, Adhesives and their mechanism of formation, Composites; Compositions, Characteristics and their types.

Unit – V

Nanomaterials:General Introduction, Fullerenes, Carbon nanotubes,

Nanowires, Electronic and Mechanical properties, Synthesis of nanomaterials, Top down and Bottom up approaches, Applications of nanomaterials. Applications of biotechnology. Alloys: Types, ferrous/Non-ferrous (Carbon Steel Alloy).

Reference /Text books:

- "Basic Inorganic Chemistry" Cotton, F A Wikkinson G. and Gaus, P L John Willey & Sons. Inc. Singapore, 3rd Edition. 1996.
- Engineering Chemistry by Jain & Jain
- University General Chemistry by Petersykes, Orient Longman.
- Instrumental methods & analysis by Willard, Merritt Deam, settle.
- Analytical chemistry by Gary d. Christian.
- Engineering chemistry by Dr. Sunita Ratan.

Course Outcomes

CO1: Understanding the instrumental methods of analysis
CO2: Exploring the chemical methods and phase rule
CO3: Expanding the knowledge of electrochemistry and surfactants
CO4: Understanding the mechanism, classification, properties and applications of polymers
CO5: Understanding composites and nanomaterials

ENGINEERING MATHEMATICS I

Paper Code	**AS-104**
Course Credits	**4**
No. of Lectures / week	3
No. of Tutorials/week	1

Course Description

Unit – I

Curve Tracing & Applications of Definite Integrals: Two-Dimensional curve tracing in Cartesian, polar and parametric forms, Double points & points of inflexion, Oblique and parallel asymptotes, Finding length, volume and surface area of the curve in Cartesian, polar and parametric forms.

Unit – II

Techniques Of One Variable Calculus & Partial Differentiations: Leibnitz's theorem; nth derivative of F(x) at x=0, Maclaurin's expansion of F(x), Formation of Intrinsic and pedal equations, Partial derivatives and their geometrical interpretation, Total derivative, Total differential coefficient, change of variables i.e. use of Jacobeans.

Curvature and radius of curvature in Cartesian, polar and parametric and implicit forms, Radius of curvature at the origin, centre and chord of curvature, and evolutes of the curves.

Unit – III

Calculus of Several Variables & Linear Algebra:Taylor's expansion of a function of one & two variables, Leibnitz's rule for differentiation under the sign of integration, Maxima and minima of a function of two and more variables including Lagrange's method.

Consistency of a system of simultaneous linear equations using rank, Eigen values and Eigen vectors of a square matrix, Properties of Eigen values, Applications of Cayley-Hamilton theorem and diagonalization of a matrix, vector space, basis, linear dependence and independence of vectors, Linear transformations and related problems.

Unit – IV

Ordinary Differential Equations:Orthogonal and Isogonal trajectories of a family of curves, Complementary function, particular integral and general solution of ordinary linear differential equations of higher order with constant and variable coefficients (Cauchy and Legendre forms).

Method of variation of parameters Method of undetermined coefficients and solutions of simultaneous differential equations with constant coefficients.

Unit – V

Partial Differential Equations: Introduction to partial differential equations, Change of independent variables in P.D.E., Complete solution of homogeneous and non-homogeneous L.P.D.E. of higher order with constant and variable coefficients.

Solutions of one-dimensional wave equation, one dimensional heat conduction equations and two-dimensional Laplace (Cartesian and polar forms) equation using method of separation of variables.

Reference /Text books:

- A.B. Mathur& V.P. Jaggi: A text book of "Engg. Maths. & Advanced Engg. Mathematics"
- V.P.Mishra: "Concept of Engineering Mathematics" (Revised Edition)
- B.S. Grewal: "Engineering Mathematics & Higher Engineering Mathematics"
- B.V. Ramana: "Higher Engineering Mathematics".
- R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics", 4th Edition

  "Applied Mathematics": Dr. J.S.Bindra&K.S. Gill, S.K. Kataria& Sons, Ansari Road, Darya Ganj, Delhi-110002.

Course Outcomes

CO1: Tracing the curve and understanding its behaviour at the point of infinity (Asymptote).

CO2: Learning the concepts of successive differentiation and the expansion of functions in form of series.

CO3: Finding maxima and minima of a function of two and more variables and the concept of eigen values.

CO4: A study of ordinary differential equations and its applications.

CO5: Learning the concepts of partial differential equations with applications.

BASICS OF MECHANICAL ENGINEERING

Paper Code	**ME-101**
Course Credits	**3**
No. of Lectures / week	3
No. of Tutorials/week	0

Course Description

Unit – I

Kinematics of Rigid Bodies: Translation, Rotation About a Fixed Axis, Motion of rotation with constant angular velocity and uniform angular acceleration, General Plane Motion, Absolute & Relative Velocity and Acceleration in Plane Motion, Instantaneous Centre of Rotation in Plane Motion, Analysis of Plane Motion in Terms of a Parameter. Three-Dimensional Motion of a Particle Relative to a Rotating Frame.

Unit – II

Plane Motion of Rigid Bodies: D'Alembert's Principle, Motion of translation, centroidal rotations, non-centroidal rotations, motion of rolling bodies Axioms of the Mechanics of Rigid Bodies, Systems of Rigid Bodies, Constrained Plane Motion, Energy and Momentum Methods Principle of Work and Energy for Rigid Body, Work of Forces Acting on a Rigid Body, Conservation of Energy, Power, Principle of Impulse and Momentum for the Plane Motion of a Rigid Body.

Unit – III

Properties, Macroscopic Versus Microscopic View point, Thermodynamic System and Control Volume, Processes and Cycles, Thermodynamic Equilibrium, Quasi-Static Process, Concept of Continuum Thermostatic, Units and Dimensions Work Transfer, P-dV Work or Displacement Work, Other Types of Work Transfer and Heat Transfer – A Path Function, Specific Heat and Latent Heat, Work Transfer.

Zeroth Law of Thermodynamics, Measurement of Temperature, Ideal Gas Thermometers, Celsius Temperature Scale, Electrical Resistance Thermometer, Thermocouple.

Unit – IV

First Law of thermodynamics for a Closed System Undergoing a process and a Cycle, Energy-A Property of the System, Different Forms of Energy, Specific Heat at Constant Volume, Enthalpy, Specific heat at Constant Pressure. Energy of an isolated system.

First Law Applied to Flow Processes, Control Volume, steady Flow Process, Mass Balance and Energy Balance in a Simple and Steady Flow Processes; Comparison of S.F.E.E. with Euler and Bernoulli Equations, Numerical

Unit – V

Second Law of Thermodynamics, Thermal reservoirs, heat pump and

	refrigerator, Statements of second law of thermodynamics, Kelvin Planck and Clausius statements and their equivalence, Carnot's theorem, Clausius inequality; Numerical
Text books:	• Vector Mechanics for Engineers: Statics and Dynamics, Tenth Edition: by Ferdinand P. Beer, E. Russell Johnston, Jr., David F. Mazurek, and Phillip J. Cornwell, Tata McGraw Hill
Reference books	• Engineering Thermodynamics by: P. K. Nag, TMH. • Fundamental of classical thermodynamics by: Wan-Wylen&sontag, John wiley&sons. • Engineering thermodynamics by: Spalding & code. • Engineering Mechanics: Statics and Dynamics: by J. L. Meriam and L. G. Kraige, John Wiley & Sons, Inc. • Engineering Mechanics: Dynamics: 12th Edition by R. C. Hibbeler, Prentice Hall Engineering Mechanics: by K.L. Kumar, Tata Mc Graw Hill.
Course Outcomes	CO1: To study and analyze the Kinematics of Rigid Bodies CO2: Developing a basic knowledge of Plane Motion of Rigid Bodies CO3: Understanding various thermodynamic systems, properties and other related concepts. CO4: Expanding the knowledge of reversible and irreversible cycles. CO5: Learning the basics of first law and second law equation and related theories with numerical.

BASICS OF CIVIL & ENVIRONMENTAL ENGINEERING

Paper Code	**CE- 101**
Course Credits	**3**
No. of Lectures / week	2
No. of Tutorials/week	1

Course Description

Unit – I

Stresses & Strains: Introduction, normal stress & strain shear stress & strain, relationship between stress and strain, Uniaxial tension test: Stress-Strain diagrams for different materials, Mechanical properties of materials, Uniaxial deformations: Saint Venants principle, principle of superposition, free body diagrams, bars of uniform cross sections. Uniaxial Deformations: bars of variable cross sections, compound/composite bars, temperature stress.

Unit – II

Analysis of Stresses: Tensor notations, equilibrium equations, transformation of stresses, invariants of stress tensor, Plane stress condition, principal stresses, maximum shear stress and their planes, Mohr's circle.

Unit – III

Analysis of Strains: Transformation of strains, invariants of stain tensor, plane strain condition, principal strains, maximum shear strain and their planes; Strain Rosettes; Stress-Strain relationship, generalized Hooke's law, relation between elastic constants.

Unit – IV

Basics of Environments: Adverse Effect of Environmental Pollution, Pollution Control Strategies, Air Pollution: Sources, Effects on Human Health, Vegetation and Materials, Global Warming, Acid Rains, Ozone Depletion-Causes, Effects and Control.

Unit – V

Pollutions and Control: Water Pollution, Sources of Water Pollution, Effects of Water Pollution, Water Borne Diseases, Water Quality Standards, Water Pollution Control. Noise Pollution, Indoor and Outdoor sources of noise pollution, Effects of Noise Pollution, Noise Standards, Noise Pollution controls.

Reference /Text books:

- Engineering Mechanics of solids by E.P.Popov, Pearson Education.
- Solid Mechanics by S.M.A.Kazimi, Tata McGraw Hill.
  Basics civil and Environmental Engineering by C.P. Kaushik, S.S. Bhavakatti and Anubha Khaushik.

Course Outcomes

CO1: Understand and determine the engineering properties for metals and non-metals

CO2: Understand the concepts of shear force, bending moment, axial force for statically determinate beams and compound beams having internal hinges and subsequently its application to draw the shear force, bending moment and axial force diagrams

CO3: Study the behaviour of structural member under the action of axial load, bending and twisting moment

CO4: Study the deformation of axially loaded columns having different end conditions and further evaluate the strength of these columns

CO5: Learning of sources of air, water and noise pollution and their effects on human health and measures of their control

BASICS OF ELECTRICAL ENGINEERING

Paper Code	**EES – 101**
Course Credits	**3**
No. of Lectures / week	2
No. of Tutorials/week	1

Course Description

Unit – I

Fundamentals of electric circuits, Kirchhoff's laws, mesh analysis, node analysis, delta-star and star-delta conversion, classification of network elements, Thevenin's theorem, Norton's theorem maximum power transfer theorem, superposition theorem.

Unit – II

Single phase AC circuits, average and effective values of sinusoids, solution of R, L, C series circuits, the j operator, complex representation of impedances, phasor diagram, concept of power factor, power factor improvement, power in complex notation, solution of parallel and series-parallel circuits, resonance. Introduction to balance three phase AC circuits

Unit – III

Ampere's circuital law, B-H curve, solution of magnetic circuits, hysteresis and eddy current losses. Relays as an application of magnetic force. Transformers- construction, e.m.f. equation, ratings, phasor diagram for no load and full load, equivalent circuit, regulation and efficiency calculations, open circuit and short circuit tests, Introduction to Auto-Transformer.

Unit – IV

Introduction to Electromechanical Energy Conversion, DC motors-construction, e.m.f. and torque equations, characteristics of DC generators and motors, speed control of DC motors. DC motor starter- working principle, ratings. Introduction to three phase induction motor, Introduction to alternator and synchronous motor and their applications.

Unit – V

PMMC instruments, shunts and multipliers, multi-meters, moving iron ammeters and voltmeters, dynamometer wattmeter, AC watt-hour meters, extension of instrument ranges.

Reference /Text books:

- D.C. Kulshrestha, "Basic Electrical Engineering", Tata McGraw Hill.
- T.K. Nagsarkar & M.S. Sukhija, "Basic Electrical Engineering", Edition 2008, Oxford University Press.
- 1. V. Del Torro, Electrical Engineering Fundamentals, Second Edition, Prentice Hall of India Pvt. Ltd.
- E. Hughes, Electrical Technology, English Language Book Society Publication with Longman.

- H. Cotton, Advanced Electrical Technology, Issae Pitman, London.

Course Outcomes

CO1: Learn to analyse circuit systems using direct application of Kirchhoff current and voltage laws along with Ohms law
CO2: To understand basic concept of "*j*" operator, RLC series circuit, reactive power, true power and apparent power
CO3: To prepare the students to have basic knowledge of transformers, the equivalent circuit model of single-phase transformers, transformer parameters using open circuit and short circuit tests, compute transformer efficiency and voltage regulation
CO4: Construction and understanding of working principles of DC generators and motors
CO5: The ability to select a suitable measuring instrument for a given application like PMMC and MI

HUMAN RESOURCE MANAGEMENT

Paper Code	**AS-201**
Course Credits	**3**
No. of Lectures / week	3
No. of Tutorials/week	0

Course Objective: The objective of the course is to enable the students to understand the key concept, systems and process about management of people and to provide a framework of using HR practices for organizational excellence. Moreover, Unit (II-V) will be both theoretical as well as experimental based. Unit (II-V) shall comprise of some elements of testing / lab exposure/ experiments.

Course Description

Unit – I

Foundation of Human Resource Management (HRM): Meaning, definition, nature and scope, characteristic, objectives, Opportunities and challenges in HRM, HRM functions.

Unit – II

Acquisition of Human Resources: *Human Resource Planning (HRP):* need, objectives, determinates, HRP models, HRP process, type of HRP, benefits; *Job Analysis (JA):* sources, methods, process, uses, importance; job description, job specification; Recruitment and selection: sources, process, barriers, objectives, objectives of selection, selection tests, interview, induction, placement and employee socialization.

Unit – III

Appraising and evaluating Human Resources:
Performance Appraisal (PA) and feedback: approaches, methods/techniques of PA, process of PA, interview, elements, designing and conducting PA; *Job Evaluation (JE):* principles, process, methods of JE, importance and limitations.

Unit – IV

Development of Human Resources:
Human Resource Development (HRD): functions, benefits, importance, barriers to HRD; *Training and Development*: models, methods, training process, training evaluation and barriers.

Unit – V

Employees Health & Wellbeing – Job stress and Job Burnout: Nature, Causes and consequences;
Stress: Nature, Causes and consequences; *Management of Stress:* Personal and organizational based strategies; *Burnout:* Nature, symptoms, causes, relationship with stress, burnout and job satisfaction management of burnout.

Prescribed Text books:

- Gary Dessler (2015), Human Resource Management, Person

	Prentice Hall of India, New Delhi. VSP Rao, Human Resource Management, Text & Cases (2nd edition), Excel Books, New Delhi.
Reference books:	• Tapomony Deb, (2009), Managing Human Resource and Industrial Relations (First edition), Excel Books, New Delhi John M. Ivancevich (2005), Human Resource Management 93rd edition) Tata McGraw Hill Publishing Co. Ltd., New Delhi
Course Outcomes:	CO1: Forming a Foundation of Human Resource Management. CO2: Understanding the procedure of acquisition of Human Resources. CO3: Making clear the importance of appraisals and evaluation in Human Resource Management. CO4: Learning importance of training and development of Human Resources. CO5: Analyzing the management of job stress and Employee health and well-being.
Lab Exercises:	▪ Administration of relevant tests as per requirement of the content of unit. Such as job satisfaction & Personality tests, Job stress tests etc. ▪ Group activities; such as case studies as per topic of the unit.

INNOVATIVE TECHNOLOGY & BIO-SCIENCE

Paper Code	**AS-105**
Course Credits	**4**
No. of Lectures/Week	**3**
Tutorial	**1**

Unit I **Introduction to Nanotechnology:**

Introduction to Nanotechnology, Theoretical Basis of nanotechnology, Quantum confinement and size effect, Classification of Nanomaterials: Nanowires, Quantum Well and Quantum Dots, Properties of Nanomaterials, Carbonaceous Nanomaterials and their examples. Molecular Nanotechnology, Green Nanotechnology.

Unit II **Applications of Nanotechnology**

Micro electro mechanical Systems (MEMS)&Nano-electro-mechanical Systems (NEMS),Nanorobotics,Nanofluidics,Micro-gearsandNano-gears,Nano-composites and their applications, Nanomaterials for Civil Engineers, Nano-paints, Light and flexible Civil Engg. Structures based on carbon Nanomaterials, Nano-memories. Nano- sensors. Nano-transistors, Introduction to organic electronics.

Unit III **Introduction to Biological Sciences**

Introduction to the cell as a unit of life, Principles involved in the maintenance of life processes, Ultra-structure and function of cellular components-Prokaryotic and Eukaryotic cells, cell wall, plasma membrane, endoplasmic reticulum, Biomolecules-Carbohydrates. Lipids, Amino Acids, proteins, Nucleic Acids, Tissue Systems. Metabolism, Chromosomes and Cell Division. Basic Genetics-biological indicators, bio-sensors, Mutation-causes, types and effect.

Unit IV **Advanced Biological Sciences**

Introduction to microbiology, Industrial microbiology, introduction to immunology, Introduction to molecular genetics, Structure of RNA aid DNA, Concept of Gene, Gene regulation, Basicconceptsof biotechnology: Totipotency and cell manipulation, Classifications of biotechnologies

Unit V **Nano- biotechnology**

Introduction to Nano-biotechnology, Nanobiotechnology in medicine: regenerative medicine, Targeted drug delivery. Nanotechnology in pharmacy, Nanobiotechnology in Ayurveda, Alternative medicines. Nanobiotechnology in Agricultural, industrial Nanobiotechnology, Nanoimaging, Cancer treatment using Nanotechnology.

Course Outcomes:

CO1: Understanding the concept of nanotechnology
CO2: Learning the applications of nanotechnology in multiple disciplines.
CO3: Introducing concepts of Biological Sciences and basic Genetics-bio indicators and biosensors.
CO4: Advancing the field of Biological Sciences and Biotechnology.
CO5: Introduction to Nano biotechnology and its various applications.

Reference books:

1. Introduction to Nanotechnology, by Charles P. Poole, Jr., Frank J. Owens, John Wiley &Sons, 2003.
2. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, by Guozhong Cao, Ying Wang. World Scientific publishing, 2011.
3. Nanoscience: Nanobiotechnology and Nanobiology, edited by Patrick Boisseau, Marcel Lahmani, Springer, 2010.

ENGINEERING PHYSICS – II

Paper Code	**AS-202**
Course Credits	**3**
No. of Lectures/Week	**2**
Tutorial	**1**

Unit I **RELATIVITY**

Difficulties of classical theory, idea of ether, Michelson Morley Experiment, Galilean transformations, postulates of special theory of relativity, Lorentz transformations, Einstein velocity addition theorem, time dilation, length contraction, relativistic mass, momentum and energy, natural units, principle of equivalence.

Unit II **LASERS**

Principle of laser action, Einstein's transition probabilities, lifetime of transitions, rate equation for atomic transition, optical resonators, ruby laser, He-Ne laser, general characteristics of lasers, applications of lasers.

Unit III **QUANTUM THEORY**

Schrodinger equation, time dependent and independent forms, wave function, probabilistic interpretation, one-dimensional problems, particle in a box, elementary treatment of harmonic oscillator, potential barrier and possibility of tunneling.

Unit IV **PHYSICS OF MATERIALS**

Bose Einstein statistics, Fermi Dirac statistics, semiconductors, intrinsic and extrinsic, carrier concentration, origin of energy gap, Kronig Penney model, Basics of semiconductor devices and applications, Electrical & optical properties.

Unit V **FRONTIERS OF PHYSICS**

Basic interactions, symmetry, invariance and conservation laws, elementary particles and their classification, accelerator physics and applications, last Nobel Prize in Physics, its back ground, significance and possibilities of future developments.

Course Outcomes:

CO1: Learn to apply relativity in describing physics of motion
CO2: Appreciate the importance of lasers and grasp the physical bases
CO3: Learn the calculation methods of quantum theory
CO4: Apply quantum ideas to explain behaviour of materials
CO5: Appreciate physics conservation laws and be acquainted with new areas

Reference/ Text books:

1. Resnick Halliday: Physics
2. Beiser: Modern Physics

3. Mani and Mehta: Modern Physics
4. Garcia and Damask: Physics for computer science
5. Thyagrajan: Laser

ENGINEERING CHEMISTRY & ENVIRONMENTAL SCIENCE

Paper Code	**AS-203**
Course Credits	**3**
No. of Lectures/Week	**2**
Tutorial	**1**

Unit I **WATER TREATMENT:**

Water Quality Parameters (BIS & WHO Standards), types of hardness, Units, Determination of hardness by EDTA method, Alkalinity of water & its significance, Numerical problems, Problems with boiler feed water and its treatment; Scale & Sludge formation, Boiler corrosion, Caustic embrittlement, Priming & foaming, Softening methods; Lime-soda, Zeolite & Ion Exchange processes, Numerical problems, Chlorination of water, Coagulation, Sedimentation and Desalination.

Unit II **ENERGY RESOURCES:**

Types of fuels, Calorific values, (HCV & LCV) and determinations by Bomb and Boys gas calorimeter, Numerical problems, Coal; Types of coal, Analysis of coal, Liquid Fuel; Refining of petroleum, Knocking, Octane and Certance Values, Pollution from fossil fuels, Combustion and Problems. Renewable; (Solar Cells, Rechargeable Batteries, Fuel Cells) and Non-renewable of energy; (Wind Energy, Geothermal Energy, Ocean Energy) resources of Energy.

Unit III **CORROSION AND ITS PROTECTION:**

Corrosion; Definition and its scope, Chemical Corrosion, Electrochemical Corrosion, Mechanism of Chemical and Electrochemical Corrosion, Types of Corrosion; Intergranular Corrosion, Soil Corrosion, Waterline Corrosion, Differential Aeration Corrosion, Galvanic and Concentration Cell Corrosion, Factors affecting corrosion, Protection of corrosion.

Unit IV **ENVIRONMENTAL CHEMISTRY:**

Environment and its Segments, Zones of Atmosphere, Air Pollution: Air pollutants and their resources; Aerosol and its Types, RSPM, SPM, Acid rain, Green House Effect, Global warming, Ozone Layer Depletion, Water Pollution; Sources of water pollution, Sewage Treatment, Determination and Significance of COD, BOD, TOC. Noise Pollution, Soil Pollution, Radioactive Pollution and e-Waste.

Unit V **ENVIRONMENTAL BIOTECHNOLOGY:**

Biotechnology and its applications, fermentation, production of alcohol and vitamins, Biotechnology for environmental Protection, Biological indicators, biosensors, bioremediation, Phytoremediation, bio-pesticides, bio-fertilizers, bioreactors, Social issues, biodiversity and its conservation.

Course Outcomes:

CO1: Understanding importance of use of water in industries, softening methods and problems on water treatment
CO2: Understanding basis of fuels analysis and their combustion
CO3: Exploring the corrosion and protection.
CO4: Understanding environment and pollution
CO5: Understanding environmental biochemistry

Reference/ Text books:

1. A Basic course in Environmental studies by S. Deswal and A. Deswal.
2. Fundamental of Environments studies by Mahua Basu and S. Xavier.
3. Engineering chemistry by P.C.Jain.
4. Engg. Chemistry by Dr. Sunita Ratan.

ENGINEERING MATHEMATICS II

Paper Code	**AS-204**
Course Credits	**4**
No. of Lectures/Week	**3**
Tutorial	**1**

Unit I **SOLID GEOMETRY & MULTIPLE INTEGRALS**

Formation of equations of cylinder and cone under the given geometricalconditions, Tracing of some quadric (or Conicoids) three dimensional surfaces.

Evaluation of multiple integrals by change of order of integration, Change of variables i.e. Use of Jacobian& Applications of multiple integrals in finding plane area, mass, centre of gravity, centre of pressure, moment of inertia, product of inertia, curved surface area and volume.

Unit II **ORDINARY& PARTIAL DIFFERENTIAL EQUATIONS**

Ordinary point and regular singular point, Series solutions of ordinary differential equations of second order with variable coefficients (polynomials) by the method of Frobenius; Lagrange's method of undetermined multipliers for the solution of linear partial differential equations of first order solution of non-linear partial differential equations of first order by means of transformations and Charpits methods.

Unit III **COMPLEX ANALYSIS**

Analytical function, C-R equations in Cartesian and polar forms, Geometrical representation of $\omega=F(z)$, Determination of conjugate harmonic function, Milne – Thomson meyhod and related problems; Evaluation of complex integrals using Cauchy's integral theorem, Cauchy's integral formula for the nth order derivative of an analytic function.

Taylor series, Maclaurin series and Laurent series expansions of functions, Conformal mapping, sufficient condition for conformality of $W=f(z)$, some standard transformations; zeros, singularities and residues of an analytic function, Application of Cauchy's residue theorem in solving contour integrals and evaluation of real definite integrals using residue method.

Unit IV **LAPLACE TRANSFORM & ITS APPLICATIONS**

Laplace and inverse Laplace transforms of some well-known elementary functions and Special functions, Change of scale property, First and second shifting theorems, Laplace transforms of Derivative, Integral, $tnf(t)$, $f(t)/t$, Convolution theorem & Periodic function.

Applications of Laplace and inverse Laplace transform in finding the particular solutions of ordinary linear differential equations with constants and variables coefficients, system of differential equations, integral equation, Integro-differential equations, difference equations and, conversion of differential equations into integral equations & vice versa.

Unit V **FUZZY MATHEMATICS**

Fuzzy set, elements of Fuzzy logic, Relations including operations, reflexivity, symmetry and transitivity, Pattern classification based on fuzzy relations, fuzzy analysis including metric spaces, distance between fuzzy sets, area perimeter, height, width of fuzzy subsets, continuity & integrals.

Course Outcomes:

CO1: Tracing of 3D curves and evaluation of multiple integrals by change of variables/change of order of integration.
CO2: Learning the concepts of non-linear ordinary and partial differential equations.
CO3: Study of analytical functions, residues and conformal mapping.
CO4: Solutions of system of differential equations, integral equation, Integro-differential equations, difference equations using Laplace transformation.
CO5: Theory of Fuzzy Mathematics with its applications.

Reference/ Text books:

1. A.B. Mathur& V.P. Jaggi: "Engineering. Mathematics & Advanced Engineering Mathematics" (two volume)
2. V.P.Mishra: "Concept of Engineering Mathematics" (Revised Edition)
3. B.S. Grewal: "Engineering Mathematics & Higher Engineering Mathematics",43rd Edition
4. B.V. Ramana: "Higher Engineering Mathematics".
5. R.K. Jain and S.R.K. Iyengar : "Advanced Engineering Mathematics" 4th Edition

BASICS OF ELECTRONICS & COMMUNICATION ENGINEERING

Paper Code	**ECS-201**
Course Credits	**3**
No. of Lectures/Week	**3**
Tutorial	**0**

Unit I **SEMICONDUCTOR DIODES:**

P-N junction diode, V-I characteristics, static and resistance, linear and non-linear applications of diodes; half wave, full wave and bridge rectifiers, Zener diode, characteristics and its use as a voltage regulator, AND, OR, NAND, NOR and Ex-OR gates.

Unit II **TRANSISTORS (BJT&JFET):**

Bipolar junction transistor (BJT), biasing and amplifier action, load line analysis of transistor amplifier, BJT amplifier configurations and their comparison using small signal h-parameter model, Junction field Effect transistor (FET), biasing and amplifier action.

Unit III **OPERATIONAL AMPLIFIER:**

Op-am- basics, practical p-amp circuits, inverting and non-inverting amplifier, summing amplifier, integrators and differentiators.

Unit IV **FEEDBACK AND ELECTRONIC INSTRUMENTS:**

Feedback concept, Barkhausen Criteria of oscillation, Wein Bridge and phase shit oscillator, cathode Ray oscilloscope (CRO), electronics multimeters.

Unit V **COMMUNICATION SYSTEMS:**

Introduction to modulation, amplitude modulation generation of AM waves, demodulation of AM wave, introduction to FM.

Course Outcomes:

CO1: Studying semiconductor diodes and their various characteristics.
CO2: Expanding the ideas: construction and working of BJTs and introducing JFET.
CO3: Exploring various types of Operational Amplifiers.
CO4: Understanding the idea of Feedback and thus studying various Electronic Instruments.
CO5: Introduction to various parameters of Communication Systems.

Text books/ Reference books:

1. Microelectronics 2nd Edition, by 1 Millman and A. Grabel, Mc Graw Hill International Edition 1988.
2. Electronic Devices and Circuit Theory 5th Edition, by Robert Boyestad and Louisnashlesky, PH1 1992
3. Electronic Circuits – discrete and Integrated, by Schilling and Belove , Mc Graw Hill International Edition, 1988.

FUNDAMENTALS OF COMPUTING

Paper Code	**CS-101**
Course Credits	**3**
No. of Lectures/Week	**2**
Tutorial	**1**

Unit I **BASICS OF COMPUTERS:**

Computer fundamentals, Bits and Bytes, Generations of Computers, Classification of Computers, CPU, Memory, Input and Output Devices, Applications Software & System Software, Number system: Decimal, Binary, Octal, Hexadecimal.

Unit II **C PROGRAMMING:**

Flow Chart, Algorithms, The C character set, constants, variable, keywords, operator and expressions, decision controls, loops, case, functions, call by value and by reference, array, single dimensional, 2 dimensional, multidimensional arrays, Basic Concept of pointers & Structure.

Unit III **SEARCHING & SORTING:**

Searching and Sorting techniques, linear search, Binary Search, Bubble Sort, Strings, library string functions.

Unit IV **OPERATING SYSTEM:**

OS definition, Role of OS in computer system, multi programming, time sharing, multitasking, multiprocessing, Multiprocessor andits type, cluster system, Real Time system, Client Server Computing, distributed OS, function of OS, user interface, CLI & GUI.

Unit V **NETWORKING & DBMS:**

Network, communication models, transmission media, connection topologies, LAN, WAN, MAN, ISO-OSI model of networking, Internet, ISP, WWW, Email, URL, Web browsers, websites, intranet. DBMS, DBMS applications, Advantage of DBMS, Data Model.

CO1: Students will able to understand the basics of computer, generation & types of computers, its components and number system

CO2: Student will able to understand the concept of algorithms, flowchart and c programming language

CO3: Student will able to develop c programs for string manipulation, sorting and searching techniques

CO4: Students will able to describe the functions, structure and different types of operating systems

CO5: Students will able to understand basics of networking, internet and database management systems

Text books/ Reference books:

- "Computer Fundamentals & Programming in C", Reema Thareja, Oxford University Press
- Ashok Kamthane, "Programming with C ".
- M N Doja, "Introduction to Computers and Information Technology"
- C Programming by Yaswant Kanetkar

- "An Introduction to Database Systems", C. J. Date, Pearson Education."
- "Let Us C" by YashwantKanetkar, BPB Publication".

Course Syllabi

B.Tech.(Mechanical Engineering)

THIRD Semester

MECHANICS OF SOLIDS

Paper Code	**ME – 301**
Course Credits	**4**
No. of Lectures / week	3
No. of Tutorials/week	1

Course Description

Unit - I

Introduction: Concept of stress at a point, Principal stress and strain due to combination of stresses.

Torsion: Stresses and strains in pure torsion of solid circular shafts and hollow circular shafts. Power transmitted by shafts; combined bending and torsion. Composite shaft-series connection

Material properties and Testing: Properties in tension, shear and compression.

Unit - II

Shear force & Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, udl., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections.

Unit - III

Deflection of Beams: Area moment method. Application of area moment method to cantilever, simply supported and indeterminate beams. Advantages and disadvantage of fixed and continuous beams. Macaulay method. Castigliano's theorem and calculations of deflection of beams under single and several loads.

Unit - IV

Columns & Struts: Stability of columns. Critical loads for columns under different end conditions. Euler's and Secant formulae. Rankine formula. Design of columns under centric load Eccentrically loaded columns and their design. Kernel of a section. Laterally loaded columns.

Unit - V

Experimental Stress Analysis: Effect of strain gradient. Requirements of a strain gauge Types of strain gauges; Mechanical, Optical, Acoustical and Electrical gauges, Strain sensitivity of a conductor. Temperature strains. Gauge factor. Introduction to Strain Rosette, Analysis of rectangular rosette, Δ rosette and T rosette. Material for strain gauge.

Pre-Requisite Courses (/ Papers):

- Engineering Mechanics
- Elements of Civil Engineering

Text books:	• Mechanics of Solids by Abdul Mubeen, Pearson Education • Introduction to Solid Mechanics by Shames, Prentice Hall of India Pvt. Ltd
Reference books:	• Experimental Stress Analysis by Abdul Mubeen, Dhanpat Rai and Sons. • Experimental Stress Analysis by Dally & Riley, McGraw -Hill Book Co. • Advanced Mechanics of Materials by Steel and Smith, John Wiley and Sons • Experimental Strength of Materials by Abdul Mubeen, Khanna Publishers
Course Objective	• Review and apply the principles of static equilibrium to the analysis of structures such as pressure vessels, beams, and torsion members; • Evaluate stress and strain within various structures by applying the appropriate engineering theories; • Formulate solutions to problems requiring the application of suitable engineering theories for stress and strain.
Course Outcomes	CO1: Formulating the fundamentals of engineering applications of stress and strain; and Material properties and testing. CO2: Developing the concept of Shear force and Bending moment, and formulating flexural and bending stresses. CO3: Formulate solutions to problems requiring the application of theories of deflection of beams. CO4: Recognise the principal terminology and concepts for columns and strut designing. CO5: Recall the principal analytical and graphical methods used to analyse experimental stress and strain.
Computer Usage / Software required:	ANSYS, SOLIDWORKS, MATLAB
Other details regarding this course	This course is of predominant importance in understanding the advanced subjects relating to Machine Component Design and Dynamics

MANUFACTURING PROCESSES

Paper Code	**ME – 302**
Course Credits	**3**
No. of Lectures/week	**2**
No. of Tutorials/week	1

Course Description

Unit-I

Introduction: Machine tool: Classification and function, operations and working principles. Basic elements of machine tool; Machine tool drives. Types of Machine tools.

Unit-II

Lathe and Milling: Tools, Classification, tool geometry, speed, feed and depth of cut, effect of machining parameters on surface roughness. Lathe operations; Facing, Turning, Shouldering of cylindrical shapes, drilling, reaming, boring, taper turning by different methods, thread cutting, method of cutting multiple thread.

Milling Machine, working principle, milling operations (slab, end, slot milling), cutting speed and feed, estimating machining time, different types of indexing methods.

Unit-III

Drilling: Types of drilling machines, Cutting speed, feed and depth of cut. Estimating machine time.

Reaming: Types of reamers, Reaming operations.

Broaching: Types of broaches, Types of broaching machines. Methods of broaching. Shaping, planning and slotting.

Unit-IV

Welding: Different types of welding; welding principle, principles of fusion welding, Heat Source. Emission and ionization of electric arc, Arc structure, Characteristic and power of electric arc, Modes of metal transfer in Arc welding. TIG, MIG, Resistance, Electro-slag, spot, Thermit, Friction stir welding and Laser beam welding.

Unit-V

Casting Processes: Introduction, Pattern and mould, Pattern allowances, types of pattern, types of mould, Testing of moulding sand, Preparation of mould, various stages in casting processes. Different types of casting processes (Die, Centrifugal, Continuous, and investment casting). Gating and rising system design with numerical problems.

Pre-Requisite Courses (/ Papers): Workshop Practice

Text books:	• Manufacturing Science-A. Ghosh and A.K. Malik, Affiliated East Press, New-Delhi.
Reference books:	• Campbell, J.S., Principles of Manufacturing Materials and Processes, McGraw-Hill, New-York, • De Garmo, E.P., Materials and Processes in Manufacturing, Collier Macmillan, New York. • Lindberg, R.A., Processes and Materials of Manufacturing, Allyn and Bacon, Boston, 1 • Schey, J.A., Introduction to Manufacturing Processes, McGraw-Hill, New-York.
Course Objective	To understand and analyse the major manufacturing processes including cutting, casting, joining and their supporting tools.
Course Outcomes	CO1:Understanding and classifying various operations and working principles of machine tools CO2: Advancing the knowledge of Lathe and Milling machines. CO3: Advancing on Drilling, Reaming and Broaching. CO4: Exploring various Welding processes and their characteristics. CO5: Boosting the basic knowledge of casting and its classifications.
Computer Usage / Software required:	
Other details regarding this course	Visit to manufacturing organization will help broaden the horizon.

APPLIED THERMODYNAMICS

Paper Code	**ME –303**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-I

Review of basic concept of Thermodynamics, Law of conservation of energy and First law of Thermodynamics for a closed/open system undergoing a cycle; Steady flow energy equation, Second law of thermodynamics, Energy and entropy, Reversible and irreversible processes, Second law analysis; Availability and irreversibility, Gibb's function, Helmholtz function, Clausius and Clayperon equation.

Unit-II

Thermodynamic cycles, Carnot Cycle, Joule cycle, Air standard cycle, Otto cycle, Diesel cycle, Dual cycle, Rankine cycle, Modified Rankine cycle, Thermal refinements in Rankine cycle, working of steam power plant, Binary vapour cycle.

Unit-III

Steam turbine, Types and application, Impulse and reaction turbine, compounding of impulse turbine, pressure and velocity diagrams, reaction turbines, Work output, Losses and efficiencies, Reaction turbine, velocity diagram, degree of reaction, work output, governing of turbine, Nozzles, isometric flow through nozzles, critical pressure, pressure ratio, maximum discharge, stagnation condition

Unit-IV

Condensers, types of condensers, jet and surface condensers, Compressors, Types, reciprocating, centrifugal, axial flow, single and multistage compressors, effect of inter-cooling, surging, choking and stalling

Unit-V

I.C. Engines, types, Air fuel mixture requirement, normal/abnormal combustion in S.I. and C.I. Engines, Calculation of engine performance, requirement and suitability of fuels in I.C. Engines.

Pre-Requisite Courses (/ Papers):

- Basic Thermodynamics

Text books:

- Applied Thermodynamics: P. K. Nag, Tata McGraw Hill Publications.

Reference books:

- Applied Thermodynamics Engineering technology by T. D. Eastop&McConkey, Pearson Education.
- Applied Thermodynamic Sciences. Principle Applications. S. K. Agrawal, Viva Book.

	• Turbine Compressors and Fans, S. M. Yahya, Mc-Graw Hill. • Thermal Engineering by R. K. Rajput, Laxmi Publication, Delhi.
Course Objective	This course is designed to teach mechanical engineering students the application of thermodynamic principles to the design and optimization of Thermal Engineering Systems. Specifically, students will be taught how to apply the laws of thermodynamics to vapour power and refrigeration systems, gas power systems, applications concerning humidification, dehumidification, evaporative cooling, and thermodynamics of combustion systems such as furnaces, flow reactors etc.
Course Outcomes	CO1: Able to understand the laws and limitation of thermodynamics and will be able to sort out realistic and unrealistic thermodynamic system claims. CO2: Able to analyse a vapour power cycle given a set of operational parameters and constraints, determine cycle efficiency, its power output, and required heat input. CO3: Able to understand cycle efficiency for the steam power cycle, gas turbine cycle. CO4: Able to analyse and optimize a vapour refrigeration system given the requirements and constraints of a refrigeration system. CO5: Able to analyse and determine cycle efficiency, work output and required heat input for a Petrol/Diesel engine with a given set of operating parameters.
Computer Usage / Software required:	Students can be introduced to basic simulation software such as FLUENT.
Other details regarding this course	This is a basic course necessary for further studies in Thermal Engineering and Sciences

MATERIAL SCIENCE

Paper Code	**ME –304**
Course Credits	**4**
No. of lectures/week	**3**
No. of Tutorials/week	1

Course Description

Unit – I

Introduction: Historical perspective, importance of materials in the modern development. Crystallography and Imperfections: Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. Imperfections, Defects & Dislocations concept of slip in pure and real crystals, Schmids factors.

Unit-II

Mechanical properties and Testing: True and Engineering Stress strain diagrams, Ductile & brittle material, Stress vs. strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testing of Strength testing, Hardness testing, Impact testing, Fatigue testing Creep testing,Non-destructive testing (NDT)

Micro structural Exam: Principle of optical Microscopy Preparation of samples and Microstructure examination and grain size determination. Comparative study of microstructure of various metals & alloys such as Mild steel, CI, Brass. Phase Diagram and Equilibrium Diagram: Uniary and Binary diagrams, Phase rules.Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram.

Unit – III

Ferrous materials: Brief introduction of iron and steel making furnaces. Various types of carbon steels, alloy steels and cast irons, its properties and uses.

Heat Treatment: Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and their applications. Various type Brass, Bronze, bearing materials, their properties and uses. Aluminumalloys, Alloys of Aluminium.

Unit –IV

Magnetic properties: Concept of magnetism – Dia, para, ferro, magnetism Hysteresis. Soft and hard magnetic materials, Magnetic storages. Electricproperties: Energy band concept of conductor, insulator and semi-conductor. Intrinsic & extrinsic semi-conductors. P-n junction and transistors.

Unit – V

Ceramics: Structure types and properties and applications of

	ceramics. Mechanical/Electrical behaviour and processing of Ceramics. Plastics: Various types of polymers/plastics and their applications. Mechanical behavior and processing of plastics. Future of plastics. Other materials: Brief description of other material such as optical and thermal materials, concrete, Composite Materials, fibre and particle reinforced composites and their uses. Brief introduction to Smart materials and Nano-materials and their potential applications.
Pre-Requisite Courses (/ Papers):	Physics and Chemistry.
Text books:	• W.D. Callister, Jr, – Material Science & Engineering Addition-Wesley Publication.
Reference books:	• Van Vlash – Elements of Material Science & Engineering John Wiley & Sons. • V. Raghvan – Material Science, Prentice Hall. • Narula – Material Science, TMH.
Course Objective	• To establish the basic structure/property relationships in materials through an exploration of bonding, crystalline structure, defects and diffusion phenomena. • To gain an understanding of properties, processing, and applications of metallic, ceramic, polymeric and electronic materials.
Course Learning Outcomes	CO1: Understanding the importance and basic chemistry behind materials along with crystallography and imperfections. CO2: Examining materials under various testing and their microstructural analysis. CO3: Developing the knowledge of ferrous and non-ferrous materials and their properties under heat treatment. CO4: Strengthening the concept of magnetism and energy band of various materials. CO5: Extending the study of materials to advance materials.
Other details regarding this course	This is a predominantly basic course and helps understand how to best use different material for design and manufacturing.

INSTRUMENTATION, MEASUREMENT AND CONTROL

Paper Code	**ME – 307**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1
Course Description	**Unit- I** General Concepts: Measurement, Instrumentation, significance, standards, Methods, Methods and Modes of Measurement. Instruments-Classification and functional elements of a Measurement System. Static performance characteristics-Errors and Uncertainties, Propagation of Uncertainties, Performance Parameters, Impedance. Loading and Matching. Graphical representation and curve fitting of Data- Equations of Approximating curves. Determination of Parameters in linear relationship. Method of Least square and linear least square curve fitting. Related Numerical problems. **Unit -II** Dynamic characteristics of Instruments-Dynamic Inputs, Formulation of system equations, Dynamic Response. Transducer Elements. Intermediate Elements-Amplifiers, A-D and D-A converters, filters, Terminology and conversions, Data Transmission Elements, Related Numerical Problems **Unit -III** Measurements, Methods and Applications- Force Measurement, Torque and Power Measurements, Presume Measurement (High Pressure Moderate and vacuum) Related Numerical Problems. **Unit-IV** Temperature Measurement: - Non-electrical, electrical and Radiation Methods of Temperature Measurement. Flow measurement-Primary, Secondary and special Methods of flow Measurement, Measurement of liquid Level, Biometrics and Air pollution parameters. Related Numerical Problems. **Unit- V** Control Engineering–Classification, Applications of control Engineering, Feedback control system with their block diagrams, Transfer functions of elements, systems and processes. Transient and Steady State Response of control systems, stability of control systems. Related Numerical Problems.
Pre-Requisite Courses (/ Papers):	Basic courses of Physics, Electronics and Electrical Engineering
Text books:	• Measurement Systems by Ernest O. Doebelim, Tata McGraw Hill Publication. • Instrumentation, Measurement and Analysis by Nakra and Choudhary, Tata McGraw Hill Publication.
Reference books:	• Mechanical Measurement by Beckwith and Buck, Oxford and IBH. • Instrumentation for Engineering Measurement by Dally, William and Mc

	Connell, John Wiley and Sons.
Course Objective	• To provide knowledge of Measurable quantities, their detection, acquisition, control and analysis of measurement data this is important phenomena in almost all areas of Science Engineering and Technology. • To be aware with instrument characteristics, the measurement principles, methods, constructional feature, advantages and limitations of the instruments. • To study control engineering, small and compact type control systems, their working principles and applications.
Course Outcomes	CO1: Recognise the instrument systems, their principles, methods of measuring different physical variables and analysis of data. CO2: Formulation of system equations and extending the knowledge of dynamic inputs and response. CO3: Solve problems related to measurement of Force, Torque, Power and Pressure. CO4: Acquire knowledge of recent developments in instrumentation and measurement of Temperature. CO5: Recognise the control engineering, their types, different systems and processes, their applications in Industries and House hold appliances
Computer Usage / Software required:	ANSYS, Excel, MATLAB and similar software, Lab view
Other details regarding this course	This course is of predominant importance for machine control integrating mechanical systems and futuristic development.

FLUID MECHANICS-I

Paper Code	**ME-306**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-I

Introduction: Definition of a fluid, Scope of Fluid Mechanics, Basic equations, Methods of analysis.

Fundamental concepts: Fluid as a continuum, Velocity field, Description and classification of fluid motions.

Fluid properties: Density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, bulk modulus of elasticity/compressibility, surface tension/capillarity, thermal conductivity, specific heats. **Fluid Statics:** Basic equation of fluid statics, The standard Atmosphere, pressure variation in a static fluid; incompressible liquids and gases, manometers, hydrostatic force on submerged surfaces; horizontal, vertical, inclined and curved. **Buoyancy and floatation:** Buoyant force, centre of buoyancy and centre of gravity, Stability of floating and submerged bodies. **Fluids in Rigid-Body motion:** d′Alembert's principle, fluid mass subjected to uniform acceleration and rotation.

Unit-II

Fluid Kinematics: The substantial derivative, Acceleration field of a fluid (convective and local), The stream function, Equation of streamline, Translation, Rotation and Rate of Deformation, Angular velocity, Vorticity, Circulation, Velocity potential function, properties of ψ and φ, Irrotational flows.

Reynolds Transport Theorem, Basic equations of fluid flow.

Unit-III

Fluid Kinetics: Equation of motion- Euler's equation, Bernoulli's equation; assumptions and limitations, comparison of SFEE and Bernoulli equation. Hydraulic grade line (HGL) and total energy line (TEL).

Applications of Bernoulli's Equation: Flow through orifice and mouthpiece, Pitot-static tube, Discharge measurement: Pipelines (venture-meter, nozzle-meter, orifice-meter, rotameter and elbow meter), Open channel (flow over notches and weirs), Impact of free jets.

Unit-IV

Flow through pipes: Fully developed flow, The Reynolds number, Laminar and turbulent flows, Laminar flow in pipe, Smooth and rough pipes, Pressure drop and head loss, Major and minor losses, The Moody's chart, Pipes in series and parallel, Hydraulic power transmission, Pipe flow problems.

Unit -V

Dimensional analysis and similitude: Nature of dimensional analysis, Buckingham Pi theorem, determining the Pi groups, Significant dimensionless groups in FM, Flow similarity and model studies.

Open-channel flow: Chezy's formula, specific energy, critical depth, hydraulic jump.

Pre-Requisite Courses (/Paper):	The prerequisites for this course are: vector algebra and calculus, differential equations, particle and rigid body dynamics and thermodynamics.
Text books:	• Introduction to Fluid Mechanics by **Fox & McDonald**, John Wiley & Sons, Inc. • Fluid Mechanics by **Frank M White**, Tata McGraw-Hill Pub. Company Ltd.
Reference books:	• Fluid Mechanics and Its Applications by **Vijay Gupta & Santosh K Gupta**, New Age Int. Publishers. • Introduction to Fluid Mechanics and Fluid Machines by **S K Som& G Biswas**, Tata McGraw-Hill Pub. • Foundations of Fluid Mechanics by **S. W. Yuan**, Prentice-Hall of India Pvt. Ltd. • Fluid Mechanics by **Yunus A. Cengel& John M. Cimbala**, McGraw-Hill Education Pvt. Ltd. • Fluid Mechanics and Fluid Power Engg. by **D. S. Kumar**, S. K. Kataria& Sons. • Fluid Mechanics by **John F. Douglas**, **Gasiorek, Swaffield and Jack,** Pearson Education.
Course Objective	Knowledge and understanding of the basic principles and concepts of fluid mechanics are essential to analyse any system in which a fluid is the working medium. The design of all means of transportation requires application of the principles of fluid mechanics. In recent years Vehicle manufacturers have given more consideration to aerodynamic design. The design of propulsion systems for space flight is based on the principles of fluid mechanics. It is commonplace today to perform model studies to determine the aerodynamic forces on, and flow fields around, buildings and structures.
Course Outcomes	CO1: Definition and properties of fluids (as distinct from solids), Units and dimensions, Classification of fluids, Fluid Statics. CO2: Kinematics of Fluid, Vorticity and circulationDifferential equation of conservation of mass. CO3: Dynamics of Ideal Fluid Flow: Euler's equation of motion, Bernoulli's equation and its applications, Flow measuring devices, Major and minor losses in pipe flow, Power transmission by a pipeline. CO4: The Integral Analysis of Flow, The Transport Theorem, Moment of momentum equation, Energy equation and their applications. CO5: Understanding the knowledge of various flows on the free surface.
Computer Usage / Software required:	e.g. MATLAB, EXCEL, EES etc.
Other details regarding this course	This is a basic course on fluid mechanics

ENGINEERING MATHEMATICS III

Paper Code	**AS –301**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Application of Multiple integrals and Vector Calculus: Application of Double and Triple integrals (two dimensional Cartesian, polar Coordinates; three dimensional Cartesian, cylindrical and spherical coordinates) in finding the plane area, mass, centre of gravity, moment of inertia, product of inertia, centre of pressure, curved surface area and volume. Problems of Green's theorem in x-y plane, Gauss divergence theorem, stoke's curl theorem (Cartesian form without proofs)

Unit - II

Application of Laplace Transforms: Application of Laplace Transforms in finding the particular solutions of ordinary linear differential equations of higher order with constant and variable coefficients, system of simultaneous differential equations, integral equations, integro-differential equations and differential equations.

Unit-III

Fourier series and Fourier Transforms: Fourier's series (full range and half range) for arbitrary period, Representations of a function in terms of Fourier integral, Fourier Sine integral and Fourier Cosine integral, infinite complex Fourier transform, finite and infinite Fourier Sine and Cosine transforms and their inverse transforms, Properties of transforms and associated theorems and their application in integral equations and boundary value problems.

Unit-IV

Difference Equations and Z-Transforms: Complementary function, particular integral and general solution of linear difference equations with constant and variable coefficients; Z-transforms, inverse Z-transforms and their application in particular solutions of linear difference equations with constant coefficients and simultaneous difference equations.

Unit-V

Higher Calculus: Extremals of functional (by means of Euler-Poisson equations), Isoperimetric problems, Beta and Gamma functions, Fractional derivative, Dirichlet's and Lowville's multiple integrals, Representation of a definite integral in Legendre and Jacobi forms of Elliptic integrals of First, second and third kinds.

Pre-Requisite Courses (/ Papers):	Engineering Mathematics – I & II, AS-104 & IIT Objective, Mathematics and handling of Scientific Calculator
Textbooks:	• A Textbook of Engineering Maths. & Advanced Engineering Mathematics by A.B. Mathur & V.P. Jaggi, Khanna Publisher • Elementary Engineering Maths & Higher Engineering Maths by B.S.

	Grewal, Khanna Publishers. • Advanced Engineering Mathematics by Erwin Kreyszig, John Willey and Sons, Inc.
Reference books:	• Higher Engineering Mathematics by B.V. Ramana, Tata Mc-Graw Hill • Advanced Engineering Mathematics by R.K. Jain and S.R.K. Vol. I & ii BY Rakesh Dubey, Narosa, Publishing House.
Course Objective	To understand Mathematics for Solving Engineering Problems
Course Learning Outcomes	Students will be able to solve and Model engineering problems using Mathematics.
Computer Usage / Software required:	MATLAB, EXCEL, MAXIMA, MATHEMATICA, etc.
Other details regarding this course:	Problem solving will enable students to become better engineers .

Course Syllabi

B.Tech.(Mechanical Engineering)

FOURTH Semester

HEAT AND MASS TRANSFER

Paper Code	**ME -401**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-I

Modes of Heat Transfer: Transfer of One dimensional, Heat Conduction, Resistance Concept, Electrical Analogy.

Fourier's Law of Conduction, Thermal Conductivity of Solids, Liquids and Gases, General Conduction Equation in Cartesian Coordinates and Cylindrical Coordinates, One Dimensional steady heat flow through plane wall cylinders and spheres, Heat flow through composite wall, cylinder and sphere, critical thickness of insulation. Different type of fins. Heat transfer from fin of uniform cross-section, Two-dimensional conduction through plane walls.

Unit-II

Convection: Free and forced convection, hydrodynamics and thermal boundary layers, similarity conditions of Heat Transfer Process. Equation of Momentum and Energy, Application of dimensional analysis, Empirical equation of convection Heat Transfer, condensation heat transfer, Drop-wise and film wise condensation; Laminar film on a vertical surface.

Unit-III

Boiling Heat Transfer, Pool boiling regimes, Heat Exchangers, Classification of Heat Exchange Overall Heat Transfer Coefficient, LMTD method for parallel flow & counter flow, The NTU method. Pressure Drop.

Unit-IV

Radiation: Black body radiation, Definitions, Emissive Power, Emissivity. Absorptive, Reflectivity and Transmissivity, Black, Gray, White & real Surfaces, Planck's Distribution law, Kirchoff's law, Wien's Displacement Law, Stefan Boltzman Law, Radiation Shape factor.

UNIT-V

Mass Transfer: Analogy between Mass Transfer and Heat Transfer, The conservation of Chemical Species, diffusion Mass Flux, Fick's Law, diffusion Molar Concentration and Flux, diffusion through a stationary medium, steady state diffusion through a plane membrane.

Reference Mass Coefficient, Convective Mass Transfer, Boundary Layer Concentration, Governing equations.

Pre-Requisite Courses (/ Papers):

- Thermodynamics, Applied Thermodynamics

Text books:

- Fundamentals of Engineering Heat and Mass Transfer, by R.C. Sachdeva, New Age International Publisher.

Reference books:	• Fundamentals of Momentum, Heat and Mass Transfer, by James R. Welly, Chark E. Wicks and Robert E. Wilson, & Sons. • Principles of Heat Transfer, by, Frank P. Kreith and Mark S. Bhonharpar& Row Publisher. • Basic Heat and Mass Transfer, by A.F. Mills, Prentice Hall of India. • Heat and Mass Transfer, A P. Singh, Macmillan India Ltd. • Fundamental of Heat and Mass Transfer, C.P. Kothandaraman, New Age international Publisher. • Heat transfer principles & application, B.K. Dutta
Course Objective	• Students will understand the basic concepts of conduction, convection and radiation heat transfer. • Students will understand how to formulate and be able to solve one and two-dimensional conduction heat transfer problems. Solution techniques will include both closed form and numerical methods. Convection effects will be included as boundary conditions. • Students will understand the fundamentals of the relationship between fluid flow, convection heat transfer and mass transfer. • Students will apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient. They will then calculate heat transfer rates using the coefficients. • Students will understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation. • Students will be able to evaluate radiation view factors using tables and the view factor relationships.
Course Outcomes	CO1: Basic concepts of conduction, convection and radiation heat transfer. Formulate and solve one and two-dimensional conduction heat transfer problems. CO2: Widening the concepts of convection and solving problems related to its applications. CO3: Fundamentals of heat exchangers and its analysis using LMTD and NTU methods. CO4: Strengthening the basics of radiation and understanding the related laws. CO5: Understanding mass transfer using analogy with heat transfer.
Computer Usage / Software required:	Students can be introduced to basic simulation and modelling software.

PRODUCTION ENGINEERING-I

Paper Code	**ME-402**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit-I

Principles of Metal cutting. Requirements of tool (Properties and geometry) and motions: Geometry of a single point cutting tools, effect of tool geometry elements on machining performance. Surface integrity, Orthogonal cutting. Mechanics of chip formation. Strain during machining, velocity triangle. Shear angle, Types of chips.

Unit-II

Merchant's circle for metal cutting, force balance during orthogonal machining. Machining power. Temperature rise during machining. Effect of heat and forces on the machining performance.

Unit-III

Cutting tool material. Tool wear and tool life, machinability of common engineering alloys, cutting fluid.

Plastic deformation: Role of shear, behaviour of material during plastic deformation, Yield criteria.

Unit-IV

Formability, effect of heating. Hot, warm and cold working. Technology of Rolling, types of rolling stands, defects during rolling and their alleviation. Forging, types of forging. Calculation of forging force.

Unit-V

Extrusion, and drawing. sheet metal forming: Deep Drawing, Blanking Punching.

Pre-Requisite Courses (/ Papers): Material Science, Manufacturing Processes, Workshop Practice-I & II

Text books: Manufacturing Science, by Malik A and Ghosh, Affiliated East- West Press Pvt., Ltd.

Reference books:

- Fundamentals of Metal Machining and Machine Tools, by Geoffrey Boothroyd, McGraw-Hill International Book Co.
- Fundamentals of Tools Design by Wilson, Prentice Hall.
- Manufacturing Technology by John R. Lindbergh Molly W. Williams and Robert M. Wygant.

	• Technician Manufacturing Technology by M. Hazlehurst (English Language Book Society). • Introduction to the theory of Plasticity for Engineers by Hoffman and George Sachs McGraw-Hill.
Course Objective	• To demonstrate the fundamentals of machining processes and machine tools. • To develop knowledge and importance of metal cutting parameters. • To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms. • To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes. • To develop fundamental knowledge on metal forming processes.
Course Outcomes	CO1: To develop fundamental concepts of machining, cutting tools, and quality parameters of machining parts. CO2: To relate and investigate effects of machining process parameters on machining applications. CO3: To estimate and prescribe machining condition for capacity, cutting forces, temperature and various metal forming processes. CO4: To develop fundamental concepts on material behaviours during metal forming processes. CO5: To analyze metal forming processes for forces, defects and choices for real life applications.
Computer Usage / Software required:	
Other details regarding this course	This course is predominantly important for manufacturing Industry visit will help.

CAD AND FEM

Paper Code	**ME -403**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1

Course Description

Unit -I

Introduction: Definition of CAD/CAM, Industrial Look at CAD/CAM, CAD/CAM System Evaluation Criteria, CAD/CAM Input/output devices. Basic Definitions, Software Module, CAD/CAM Software.

Geometric transformations: Introduction, Transformation of Geometric Models, Translation, Scaling, Reflection, Rotation, Homogeneous Representation, Concatenated Transformation.

Unit-II

Wire frame Modelling: Introduction, Wire-frame Model, Wire-frame Entities, Curve Representation, Parametric Representation of Analytic curves- Line, Circle, and Ellipse. Parametric Representation of Synthetic curves-Hermite Cubic Spline, Beziercurve, B-Spline curve

Surface Modelling: Introduction, Surface Models, Surface Entities, Surface Representation. Parametric Representation of Analytic Surface-Plane Surface Ruled Surface, Surface of revolution. Parametric Representation of Synthetic Surface-HermiteBicubic Surface, BezierSurface, B-Spline Surface

Unit -III

Solid Modelling: Introduction, Solid Models, Solid Entities, Boundary Representation-Introduction, Basic elements, Euler Equation Application. Constructive Solid Geometry-Introduction, CSG Tree. Sweep Representation-Introduction to Linear, Non Linear& Hybrid Sweep.

Visual Realism & CAD data exchange files: Introduction to Model-Cleanup, Hidden line and surface removal, Shading & colouring Models. Evolution of Data Exchange formats, Shape-Based Format, Product Data Based Format, ISO Standards-IGES

Unit-IV

Introduction of FEM& Concepts: Basic steps in FEM. Elements, nodes and degree of freedom. Element characteristic matrix. Different methods to derive an element characteristic matrix. Direct method to develop element stiffness matrix. Types of elements, one-dimensional elements, two-dimensional elements and their classification. Three-dimensional elements. Related problems. Isoparametric concepts. Shape functions of one dimensional element, Linear, Quadratic, cubic and quadric bar elements, shape functions of two-dimensional elements (Lagrangian and Serendipity family), shape functions of triangular elements, Derivative of shape. functions, Jacobian matrix [J]

UNIT-V

Analysis of Plane Truss and Heat Transfer Using FEML: Solution of the plane truss, Deriving element stiffness matrix (Truss Element) [k], Global stiffness matrix

	[K] and its physical meaning, Properties of [K] matrix. Solution of unknowns. Simple problem of truss having 3 bars, Potential energy approach, One dimensional problem in stress analysis and heat transfer
Pre-Requisite Courses (/ Papers):	Mathematical background through ordinary differential equations, Matrix & Vector algebra. Engineering Graphics computer.
Text books:	• Ibrahim. Zeid, "CAD/CAM: Theory and Practice", TMH. • Rogers D. F. and J. A. Adams, "Mathematical Elements of Computer Graphics", McGraw-Hill, New York
Reference books:	• Beasant C. B. and Lui C. W. K. "Computer Aided Design and Manufacturing", 3rd Edition, Affiliated East West Press Ltd., New Delhi. • Mortenson M. E., "Geometric Modeling", John Wiley, New York.
Course Objective	Computers play an important role in Engineering design and analysis. This course gives an overview of analytical treatment on of the use of computers in design and analysis to increase the overall performance of the system
Course Outcomes	CO1: Fundamental principles on hardware and software requirements in CAD/CAM. CO2: Design and drafting of simple and complex machine parts using CAD through wireframe and surface modelling. CO3: Fundamental knowledge in visualising parts using solid modelling. CO4: Building the basic concepts of FEM and understanding its various characteristics. CO5: Analysis of plane Truss and Heat transfer using FEM.
Computer Usage / Software required:	ANSYS, SOLID WORKS, CATIA, Pro/E and other CAD/FEM software
Other details regarding this course	This needs extensive practice with available software used in industry

ENGINEERING ECONOMY

Paper Code	**ME-404**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1
Course Description	**Unit-I** Introduction to Engineering Economy: Definition, the economic environment, methodology and application. Principles of Engineering Economy. Steps in engineering economic analysis. Cost concepts and its application to break-even analysis (linear) and brief introduction to non-linear cost functions. Basics of Demand, Supply and Equilibrium. Price Elasticity of Demand, Income Elasticity of Demand, Cross Elasticity of Demand, Market structure and pricing practices, Perfect competition, Monopoly, Monopolistic competition and Oligopoly. **Unit-II** Interest and money-time relationship: Simple and compound interest, notation and cash flow diagram, the concept of equivalence. Interests formulas for discrete compounding and discrete cash flows relating present and future worth of single cash flows and uniform time series (annuity), deferred annuities, annuities with beginning of period cash flows, equivalent present worth, future worth and annual worth. Interest formulas relating an arithmetic gradient series to its present and annual worth. Nominal and effective interest rates, interest problems with uniform cash flows occurring less often and more often than compounding periods, Increasing and decreasing gradients. **Unit-III** Basic methods of making economic studies: Present worth (P.W. method, annual worth (A.W.) method, future worth (F.W.) method, internal rate of return (I.R.R.) method, external rate of return (E.R.R.) method, explicit reinvestment rate of return (E.R.R.R.) method. **Unit-IV** Selection among alternatives: alternatives having identical (or not known) revenues and lives, Alternatives having identical revenues and different lives, Selection among independent alternatives. **Unit-V** Demand Estimation and Forecasting: Basic categories of forecasting method. Extrapolative methods, _simple average, moving average and exponential smoothing. Errors involved in forecast. Explanatory methods, regression analysis for linear forecaster, coefficient of correlation. Qualitative method, Delphi approach, Market survey. Depreciation and depletion: Definition and purpose, types of depreciation, capital recovery and depreciation methods

Pre-Requisite Courses (/ Papers):	Basic Mathematics
Text books:	• Principles of Engineering Economics with Applications, Zahid A. Khan, Arshad Noor Siddiquee, Brajesh Kumar, Mustufa H. Abidi. Cambridge University Press, New Delhi, India.
Reference books:	• Engineering Economy, Degarmo E. Paul, Sullivan William G. And Bontadelli James A. Macmillan Co. of Singapore. • Engineering Economy, Leyland Blank T. and Tarquin Anthony J. (1989), McGraw Hill Publishing Company Ltd., India. • Engineering Economy, Panneerselvam R. Prentice Hall of India.
Course Objective	• To explain the basic principles of engineering economy and analysis tools relevant to engineering/business projects so as to take economically sound decisions. • To acquaint engineering students with different demand forecasting methods. • To provide engineering students with an appreciation and understanding of the time value of money and its importance in making engineering decisions. • To develop skills to use tools for economic analysis of both business projects and public-sector projects. • To acquire and independently apply concepts and techniques of economic analysis used to form engineering decisions.
Course Outcomes	**CO1:** Understand the fundamentals of engineering economy, demand and supply, and market structure. **CO2:** Understand basic principles of the time value of money. Draw the cash-flow diagrams (CFD). Compute equivalent values for time based cash flows of varying complexities. **CO3:** Learn basic methods such as present worth (PW), future worth (FW), annual worth (AW), internal rate of return (IRR), external rate of return (ERR), explicit reinvestment rate of return (ERRR) for making economy studies **CO4:** Evaluate economic alternatives using the economy study methods to select the best one. **CO5:** Understand forecasting methods, forecast errors, depreciation, depletion and depreciation methods
Computer Usage / Software required:	MS. EXCEL etc.

KINEMATICS OF MACHINES

Paper Code	**ME –405**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-1

Basic Concept of Mechanisms and Machines: Link, kinematic pairs and their classifications. Kinematic chain, Mechanism and their inversions. D.O F of a mechanism. Motion and its types. Four bar chain and its inversions. Slider-crank chain. Double slider crank chain. Compound kinetic chain. Quick return motion mechanisms. Mobility of four bar linkage (Grashof's criterion) Mechanisms with lower pairs.

Unit-II

Velocity and Acceleration Analysis in Mechanisms: Analytical method for velocity and acceleration of a mechanism. Relative velocity and instantaneous center method for determination of velocities of links of a mechanism. Velocity and acceleration diagrams for different mechanisms. Klein's construction for a reciprocating engine. Coriolis component of acceleration.

Unit-III

Kinematic Synthesis of Plane Mechanism: Types of Kinematic Synthesis, Type, dimensional, number synthesis, function generation, path generation & motion generation.

Analytical Method of Dimensional Synthesis

Four bar, slider crank function generator with three accuracy points, method for complex variables, four bar linkage for specified instantaneous condition using Freudenstein's Equation. Bloch's synthesis, Graphical Methods.

Unit-IV

Gears: Motion transmitted by two-curved surface in contact. Gear nomenclature. Types of teeth. Interference and undercutting. Minimum number of teeth on gear wheel/pinion to avoid interference. Arc and path of contact in the case of straight tooth spur gears. Introduction to helical and bevel gears.

Unit-V

Gear Trains: Types of gear trains. Epicyclic and compound gear trains for change in speed. Torques and tooth loads in epicyclic gear trains.

Friction: Friction in square threaded screw, Collars and pivots: Power transmitted through friction in belts, ropes and clutches. Friction axis of a link and friction axis of a connecting rod in the slider-crank mechanism. Effect of friction in slider-crank mechanism.

Pre-Requisite Courses (/ Papers): Mechanics of solid, Mathematical differentiation and integration

Text books:

- Theory of Mechanisms and Machines by Dr.JagdishLal, Metropolitan Book, Co. Pvt. Ltd.,

Reference books:	• The Theory of machines by Thomas Bevan, CBS Publishers anddistributors • Theory of Machines and Mechanisms by J. E. Shigley and J. J. VickerMcGraw Hill Book co. • Mechanisms and Machine theory by J.S. Rao and R.Y. Dukkipati, Wiley Eastern Ltd. • Design of Mechanics by Robert L Norton, McGraw-Hill Publishing Co.
Course Objective	• Identify mechanisms and predict their motion • Calculate the degrees of freedom of mechanisms • Design mechanisms to fulfil motion generation and quick return requirements. • Determine the positions, velocities and accelerations of • links and points on mechanisms • Derive SVAJ functions to fulfil cam design specifications • Calculate dynamic joint forces of mechanisms • Balance simple rotating objects and pin-jointed four barlinkages • Use related computer programs to design, model and analyse mechanisms
Course Outcomes	CO1: Developing concepts of mechanism and machines. CO2: To Analyze the velocity and acceleration in different mechanisms. CO3: Understanding the kinematic synthesis and analysis of mechanisms. CO4: Developing the knowledge of gears and understanding the motion transmitted by two curved surfaces in contact. CO5: To impart the basic knowledge of gear trains and friction in various mechanisms.
Computer Usage / Software required:	Simulation Softwareare required to be learned.
Other details regarding this course	This is a basic course for Machine Dynamics.

NUMERIC AND SCIENTIFIC COMPUTING

Paper Code	**AS - 401**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorial/week	1

Course Description

Unit –I

Interpolation withEqual and Unequal Intervals of the Arguments:
Newton-Gregory, Gauss, Stirling and Bessel Formulae, Aitken & cubic spline interpolation methods for equal intervals; Newton's divided difference and Lagrange's formulae for unequal intervals; Inverse interpolation using Lagrange's formula, method of successive approximations and double, triple interpolation.

Unit -II

NumericalDifferentiation and Numerical Integration**:**
Numerical successive differentiation using forward, backward, central differences interpolation formulae, Lagrange's and Newton's divided difference interpolation formula. Numerical integration using Simpson's 3/8 rule, Boole's rule, Weddle's rule, Romberg integration, Gauss-Legendre, Lobatto, Radau and Guass–Chebyshev rules. Errors in Quadrature formulae and numerical double integration.

Unit- III

NumericalSolutionsofAlgebraicandTranscendental Equations:
Bisection, Regula- False position, Newton-Raphson, Graeffe's root-squaring methods for the solution of non-linear algebraic & transcendental equations involving one variable, rate of convergence and error analysis of the methods, Newton-Raphson method for the solution of a system of non-linear equations of two and three variables.

Unit- IV

Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting**:**
Gauss elimination & Gauss-Jordan methods, Ill conditioned linear system, Gauss-Seidel and Crout methods for the solution of a system of linear equations in four unknowns; General curve (linear, quadratic, exponential and other non-linear functions) fitting using method of least squares.

Unit -V

Numerical Solutions of Initial and Boundary Value Problems:
Numerical approximate solutions of a system of simultaneous and higher order ordinary differential equations using Taylor's series method, Picard's method and Runge-Kutta fourth order method; Runge-Kutta- Fehlberg method, Euler's modified and Milne's methods; Numerical solution of boundary value problems using finite difference method, shooting method and cubic spline method.

Pre-Requisite Courses (/ Papers):	Engineering Mathematics-I, II &IIT Objective Mathematics and handling the Scientific Calculator

Text books:	• Numerical methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyengar& R. K. Jain, New Age International (P) Ltd. • Introductory Methods of Numerical Analysis, Sastry, S S, Prentice Hall of India Pvt. Ltd.
Reference books:	• Numerical Methods for Engineers Steven C. Chapra& Raymond P. Canale,Tata McGraw Hill Book Co. • Computer Oriented Numerical Methods,Rajaraman; V, Prentice Hall of India Pvt. Ltd. • Elements of numerical analysis, Radhey S. Gupta, Macmillan India Ltd.
Course Objective	To understand basic Mathematics for solving Engineering Problems
Course Outcomes	Students will be able to understand computer orientated numerical methods as given below: CO1- Interpolation with Equal and Unequal Intervals of the Arguments CO2- Numerical Differentiation and Numerical Integration CO3- Numerical Solutions of Algebraic and Transcendental Equations CO4- Numerical Solution of a System of Simultaneous Linear Equations and Curve Fitting CO5- Numerical Solutions of Initial and Boundary Value Problems
Computer Usage / Software required:	MATLAB, EXCEL, MAXIMA, MATHEMATICA etc.
Other details regarding this course	Problem solving will enable students to solve Mechanical Engineering Problems.

ELECTROMECHANICAL ENERGY CONVERSION

Paper Code	**EE-401**
Course Credits	**2**
No. of Lectures/week	2
No. of Tutorials/week	0

Course Description

Unit - I

Three Phase Induction Motor: Construction, Principle of operation, torque-slip characteristics, relation between slip and speed, losses, speed control.

Unit - II

Synchronous Generator: Principle of operation, emf equation, voltage regulation by synchronous impedance method, efficiency.
Synchronous Motor: Principle of operation, effect of excitation, V-curves.

Unit - III

Single phase induction motor, Stepper motor, Switch reluctance motor, PMMC motor their characteristic and control.
Standard voltages used in generation, transmission. Generating station, sub-station: equipment and layout.

Unit - IV

Switchgear, relays, timers: their types, Introduction to PLC, ADC (Analog to digital converter), DAC (Digital to Analog converter).

Unit - V

Power Electronics and application: Characteristics of SCR, Turn ON-Off methods, rectifier, inverter, chopper, AC voltage controller, speed control of ac and dc motor.

Pre-Requisite Courses (/ Papers): Elements of Electrical and Electronics Engineering.

Text books:

- Robert Boylested, Louis Nashelky, "Electronic Devices and Circuit Theory" Sixth Edition, Prentice Hall of India Pvt. Ltd. New Delhi, India.

Reference books:

- Electric Machinery Fundamentals, Stephen J. Chapman, McGraw Hill Book Co.
- Digital Circuits and Logic Design, Morris Manno, Prentice Hall of India Pvt. Ltd., New Delhi.
- Electrical Machines, NagrathI.J. and D.P. Kothari, Tata McGraw Hill, New Delhi.
- Introduction to Power Electronics Rashid, M. H, Prentice Hall, India, New Delhi.

Course Objective To transfer the basic knowledge of electrical engineering to the students of Mechanical engineering, and also for allied Mechanical Engineering. Jobs

Course Outcomes	CO1: Understanding the concepts principles and operation of three phase induction motor CO2: Learning the working, principle and characteristics of synchronous motor and generator CO3: Expanding the knowledge of various types of motors and their characteristics CO4: Principle and design of switchgear and their types. CO5: Basics of power electronic and its application
Computer Usage / Software required:	MATLAB, etc.

Course Syllabi

B.Tech.(Mechanical Engineering)

FIFTH Semester

FLUID MECHANICS-II

Paper Code	**ME-501**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-I

Ideal fluid flows: Bernoulli equation applied to irrotational flow, The velocity potential, Elementary plane potential flows; uniform flow, source, sink, vortex and doublet, Superposition of elementary plane flows; flow past a half-body, flow past a Rankine body, flow past a cylinder, flow past a rotating cylinder, Magnus effect, Aerofoil theory.

Unit-II

Laminar flow of Viscous Incompressible Fluids: Basic equations; continuity equation, momentum equation (N-S equations), Exact solution of N-S equations; Couette flow, Hagen-Poiseuille flow, Flow between two coaxial cylinders, Flow between two concentric rotating cylinders, Low Reynolds number flows (Creeping flows); hydrodynamics of bearing lubrication.

Unit-III

Boundary layer theory and external flows: Boundary-layer concept, Boundary layer along a flat plate; boundary layer thickness, displacement thickness, momentum thickness, Boundary layer equations, Blasius solution, Momentum integral boundary layer equation, Boundary layer control. Lift and drag, Streamlining.

Unit-IV

Turbulent flow: Characteristics of turbulent flow, Laminar-turbulent transition, Mean motion and fluctuations, Governing equations for turbulent flow, Reynolds stresses, Shear stress models, Universal velocity distribution law, Turbulent flow in pipes, Turbulent boundary layer.

Unit-V

Compressible flow: Review of thermodynamics, thermodynamic relations of perfect gases, Propagation of sound waves; speed of sound, types of flow, the Mach cone, Adiabatic and isentropic flow; stagnation properties, Isentropic flow through a variable area, Isentropic flow through a convergent-divergent nozzle; critical properties, shock waves, Flow through constant area duct with friction (Fanno flow), Flow through constant area duct with heat transfer (Rayleigh flow).

Pre-Requisite Courses (/ Papers): Fluid Mechanics-I

Text books:

Reference books:

- Introduction to Fluid Mechanics by **Fox & McDonald**, John Wiley & Sons, Inc.
- Foundations of Fluid Mechanics by **S. W. Yuan**, Prentice-Hall of India Pvt. Ltd.
- Fluid Mechanics and Its Applications by **Vijay Gupta & Santosh K Gupta**, New Age Int. Publishers.
- Introduction to Fluid Mechanics and Fluid Machines by **S K Som& G Biswas**, Tata McGraw-Hill Pub.

	• Fluid Mechanics by**Pijush K. Kundu & Ira M. Cohen**, ELSEVIER, ACADEMIC PRESS. • Fluid Mechanics by **Yunus A. Cengel& John M. Cimbala**, McGraw-Hill Education Pvt. Ltd. • Fluid Mechanics by **Frank M White**, Tata McGraw-Hill Pub. Company Ltd. •
Course Objective	• Knowledge and understanding of the basic principles and concepts of fluid mechanics are essential to analyse any system in which a fluid is the working medium. • The design of all means of transportation requires application of the principles of fluid mechanics. In recent years automobile manufacturers have given more consideration to aerodynamic design. • The design of propulsion systems for space flight is based on the principles of fluid mechanics. • It is commonplace today to perform model studies to determine the aerodynamic forces on, and flow fields around, buildings and structures.
Course Outcomes	CO1: Knowledge and understanding of dimensional analysis and similitude. CO2: Understanding the laminar flow and governing the differential analysis and its continuity equation. CO3:Developing the fundamentals of turbulent flow and studying phenomenological theories of turbulence. CO4: Analysis of boundary layer theory and flow around immersed bodies. CO5: Understanding the thermodynamic relation and basic equations of compressible flow
Computer Usage / Software required:	e.g. MATLAB, EXCEL, EES etc.

DESIGN OF MECHANICAL COMPONENTS

Paper Code	**ME-502**
Course Credits	**3**
No. of Lectures/ week	2
No. of Tutorials/week	1

Course Description

Unit-I

Introduction: Introduction to Design Process & Phases of design. Design factors. Margin of safety. Working stresses. Theories of Failure. Types of joints. Types of riveted joints. Design of riveted joints. Design of welded joints. Eccentrically loaded riveted and welded joint. Cotter and Knuckle joint design.

Unit-II

Design against Fatigue: Fatigue strength. Factors affecting fatigue behaviour. Influence of superimposed static stress. Stress concentration. Notch sensitivity. Factor of safety. Cumulative damage in fatigue,Soderberg and Goodman lines, Gerber's Parabola and their Modification of Goodman's Line.Practical measures to combat fatigue.

Unit-III

Screws: Design of screw joints under tension and shear, initial loading, consideration of stiffness. Eccentrically loaded screws joints. Standard threads. Power Transmission by screws. Friction and efficiency. Examples of application: screw jack, C-Clamp, lead screw, broach actuator etc. Design of nut-screw pair for axial load and torque. Impact load on bolts.

Unit-IV

Clutches and Brakes: Function of Clutches, Friction and limiting torque. Theories of uniform pressure and wear. Classification-single & multiple plate clutches. Cone clutch. Centrifugal Clutch. Energy loss during clutching. Consideration of heat dissipation in brakes and clutches. Description of power controlled clutches. Brakes-function, types, lining material, Band, Shoe, Band and Shoe. Actuating mechanism. Maximum and average pressure. Leading and trailing shoe brakes. Disc Brakes.

Unit-V

Springs: Types of close and open coil Helical springs. Tension & compression spring. Design of helical spring. Combination in series and parallel. Leaf springs and design of leaf spring. Load on the clip bolts. Flat spiral springs. Material for springs. Method of improvement of life and strength.

Design of Pressure Vessels: Thin cylinders, Thick cylinders, Lames Equation, Compound cylinders, Spherical Vessels.

Pre-Requisite Courses (/ Papers):	Machine Drawing, Mechanics of solid and Engineering Materials
Text books:	• Mechanical Engg. Design by J.E. Shigley, C.R. Mischke

Reference books:	• Bhandari V B McGraw HI Book Co. • Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley & Sons • Design of Machine Elements by Spots, Prentice Hall of India. • Fundamentals of Mechanical Component Design by Edwards and McKee, McGraw-Hill. • Machine Design by Robert L. Norton, Prentice Hall, USA
Course Objective	To prepare a student of mechanical engineering to apply theory and practice of Design of Mechanical Elements. It is an introductory course laying foundation on design fundamentals, application of strength of material principles, selection of components and selection of materials for a given application. The objective also includes working with CATIA and other design software.
Course Outcomes	CO1: Understanding the basic concept of machine design. CO2: To apply the concept of Design against fatigue for mechanical systems. CO3: Developing the fundamental design concept for screw, rivet and welded joint. CO4: To develop and Analyze the design procedures for clutch and brakes. CO5: To develop and Analyze the design procedures for spring & Thick/Thin cylinders.
Computer Usage / Software required:	Language- C, C++ Solid works, Pro/E, CATIA,ANSYS
Other details regarding this course	Machine Design practice with the help is necessary.

MECHATRONICS

Paper Code	**ME–507**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit-I** Introduction to Mechatronics: Origin& evolution of Mecha tronics. Objectives, Advantages, And Disadvantages of Mechatronics, System Interfacing, Instrumentation and Control Systems, open and cloosed Loop Systems, Sequential Systems. Elements of Mechatronics: Sensors and Transducers, Timers. Ssignal Conditioning, Signal Nomenclature, Signal Processing. Digital Logic. Microprocessor-based Digital Control, Basic Elements of control systems, Microprocessor Architecture, Terminology, instruction Types, Addressing Models, Intel 8085A Microprocessor, Microcontrollers, Relayand Programmable Logic Controller **Unit - II** Pneumatics & Electro Pneumatics: Introduction to Pneumatics, Air Compression, Distribution and Treatment. Directional Control valves. Electro Pneumatic Components. Circuit Design. Pneumatic Actuation System, Practical Exercises **Unit-III** Actuators and Mechanisms: Actuator Types and application Areas, Electromechanical Actuators, DC Motors, AC Motors, Fluid Power Actuators, Piezoelectric Actuators, Magnetostrictive Actuators, Memory-metal Actuator, Ion-Exchange Polymer-metal Composites, Chemical Actuator, Mechanisms, Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Ratchet, Pawl and Crank, Slider and Crank, Cams and Follower, Chain and Sprocket, Geneva Wheel, Four-bar Linkages. **Unit-IV** Modelling: Systems, Modelling, Mechanical System, Electrical Systems, Fluid Systems, Thermal Systems, Engineering System, Translational Mechanical System with spring, Damper and Mass. Rotational Mechanical Systems with Spring, Damper and Mass, Modelling Electric Motor, Modelling Chamber Filled with Fluid, Modelling Pneumatic Actuator. **Unit-V** Intelligent Systems and Their Applications- Advance Actuators, Consumer Mechatronics Products, Hydraulic Fingers, Surgical

	Equipment, Industrial Robot, Autonomous Guided Vehicle (AGV),Drilling Machine, Conveyor-based Material Handling Systems. Mechatronics in Manufacturing Production Unit, Input/output and Challenges in Mechatronics Production Units, Knowledge Required For Mechatronics in Manufacturing, Main Features of Mechatronics in Manufacturing, Computer Integrated Manufacturing, just- in-Time Production Systems, Mechatronics and Allied Systems.
Pre-Requisite Courses (/ Papers):	Theory of Machines, Manufacturing Process, Basic Electrical & Electronics Engineering, Instrumentation and Control.
Textbooks:	• W. Bolton, 'Mechatronics', Pearson Education New Delhi... • N P Mahalik Mechatronics Principle, concept & Application, Tata McGraw-Hill, New Delhi
Reference books:	• Robert H. Bishop, 'Mechatronics Hand Book', CRC Press, New York • J.R Groot, 'Introduction to Pneumatics', Fluid Power Education Foundation, Milwaukee.
Course Objective	The Objective of this course is to impart the skills and knowledge that are not confined to a single subject area, but a range of engineering disciplines. Students completing a course will be capable of working in a number of interesting areas i.e. process engineering, product design, manufacturing, automation, quality and business process, green engineering and research and development.
Course Outcomes	CO1: Introduction to Mechatronics and understanding its origin, evolution and future aspects. CO2: Plan for sustainable and effective solutions through the application of mathematics, science and engineering fundamentals to study Pneumatics. CO3: Advancing the knowledge of different types of actuators and deriving various related mechanisms. CO4: Present technical and scientific findings effectively by using sophisticated modelling techniques. CO5: Introduction to modern machinery and intelligent systems used in industries.
Computer Usage / Software required:	MATLAB, EP-I.

PRODUCTION ENGINEERING -II

Paper Code	**ME-504**
Course Credits	**3**
No. of Lectures/ week	2
No. of Tutorials/week	1

Course Description

Unit-I

Linear and angular measurements- Precision gauge block, Angle gauge, Sine bar. ISO system of Limits and fits. Interferometry -e.g. optical flats,. Measurement of major diameter, minor diameter and effective diameter by bench micrometer. Errors in pitch and thread form by optical method. Measurement of gears to determine errors in run out, profile. Pitch, pressure angle and tooth thickness by anyone method. C.N.C. Measuring equipment of gears.

Unit-II

Usefulness of Jigs and Fixtures. Principles of jigs and fixtures design. Principles and types of locating and clamping devices. Elements of a drilling jig and types of jigs. Elements of a milling fixtures and types of milling fixtures. Jig and fixture economic analysis.

Unit-III

Surface measurements e.g. surface roughness, Grinding Process, Grinding operations, Modelling of plunge and surface grinding operations, Grinding wheels-materials and designation, wheel truing and dressing.

Unit-IV

Need of Unconventional manufacturing methods, Electro discharge machining, electro-chemical machining, abrasive jet machining, ultrasonic machining. Electron beam machining, Laser beam machining. Plasma Arc Machining. High velocity forming of metals- Explosive forming. Electro-hydraulic forming.

Unit-V

Structure, properties of Plastics and factors affecting properties, Plastic processing - Casting of Plastics, Compression Molding, Injection Moulding, Rotomoulding, Blow Moulding, Reinforced Plastic Moulding, Pultrusion, Filament Winding, Machining of Plastics.

Pre-Requisite Courses (/ Papers): Material Science, Production Engineering-I, Manufacturing Processes, Workshop Practice-I & II.

Text books:

- Manufacturing Science, by Mallik A and Ghosh, Affiliated East- West Press Pvt., Ltd.

Reference books:	• Fundamentals of Metal Machining and Machine Tools, by Geoffrey Boothroyd, McGraw-Hill International Book Co. • Fundamentals of Tools Design by Wilson, Prentice Hall. • Processes and Materials of Manufacture, by Roy A. Lindberg, PHI Learning. • Manufacturing Technology by John R. Lindberk Molly W. Williams and Robert M. Wygant. • Technician Manufacturing Technology by M. Hazlehurst (English Language Book Society. • Introduction to the theory of Plasticity for Engineers by Hoffman and George Sachs McGraw-Hill.
Course Objective	• To demonstrate the fundamentals of metrology and inspection. • To develop knowledge and importance of jigs and fixtures. • To develop fundamental knowledge on grinding of materials. • To develop knowledge and importance of non-conventional manufacturing processes. • To demonstrate the fundamentals of properties and processing of plastics.
Course Outcomes	CO1: Understand various methods of inspection and measurement used in industries. CO2: Understand design and use of jigs and fixtures. CO3: Understand the application of metal grinding processes. CO4: Understand the application of non-conventional manufacturing methods in different manufacturing situations. CO5: Identify the properties and processing of plastics.
Other details regarding this course	The course is of predominantly important in industry and requires industry interaction

DYNAMICS OF MACHINES

Paper Code	**ME-505**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-1

Cams: Types of cams and followers. Displacement, velocity, and acceleration diagrams for usual motion of followers. Cam profiles for knife-edge, roller and flat-faced followers. Cam size determination. Determination of motion of the follower for specified cam profiles.

Unit-II

Inertia Force Analysis: Simple and compound pendulums. Inertia force and inertia couple. Dynamically equivalent systems. Equilibrium of a link in a mechanism. Inertia force in reciprocating engines. Inertia forces in a four bar linkage. Turning moment diagrams. Fluctuation of speed and energy. Flywheel.

Unit-III

Balancing: Introduction to static and dynamic balancing. Balancing of a single and a number of rotating weights by another weight rotating in the same plane. Balancing of a number of weights rotating in different planes. Balancing of reciprocating parts of an engine. Partial balancing of primary forces. Balancing of two and four cylinder in a line engine. Balancing of V /radial engines. Direct and reverse crank method. Balancing machines.

Unit-IV

Gyroscope: Gyroscopic couple and processional motion. Effect of gyroscopic couple on a movement of aero planes, Naval ships, four wheel and two wheel vehicles. Gyroscopic Analysis for rotating shaft with inclined disc and Grinding Mills. Introduction to Gyro dynamics.

Unit-V

Governors: Function of a governor, governor's types, working of Watt Porter, Proell and Hartnell governor with and without the effect of friction at the sleeves. Qualities of a governor- sensitiveness, stability, isochronisms and hunting. Effort and power. Controlling force of a governor.

Pre-Requisite Courses (/ Papers): Theory of Machines

Text books:

- Theory of Mechanism and Machines by Ghosh &Malick, Affiliated East-West Publications.
- Theory of Machines by Thomas Bevan CBS Publishers and Distributor, N. Delhi.

Reference books:

- Theory of Machines and mechanisms, Shigley, MGH
- Mechanism and Machine Theory by J.S. Rao and R. V Oukkipati,· Wiley

	Eastern
Course Objective	The student is to learn and demonstrate proficiency in mechanism kinematics, graphical and analytical linkage synthesis, linkage position analysis, linkage velocity analysis, linkage acceleration analysis, and dynamic linkage force Analysis.
Course Outcomes	CO1: Understanding the concepts of cams and followers. CO2: Analysis of inertial force for simple and compound pendulums. CO3: Introduction to static and dynamic balancing. CO4: Gyroscope: Gyroscopic couple and processional motion. Effect of gyroscopic couple on a movement of aero planes, Introduction to Gyro dynamics. CO5: Governors: Function of a governor, governor's types, working of Watt Porter, Controlling force of a governor.
Computer Usage / Software required:	• Demonstrate a good understanding of the principles of mechanisms and machines, and their practical applications in mechanical Engineering. • Solve problems involving linkage mechanisms, balancing, and power transmission through clutches, chains, belts, gears, etc. • Select suitable mechanisms for various applications including, cams and governors. • Use friction as an advantage in mechanical engineering. Reduce friction otherwise to minimise energy losses. • Gain confidence in solving problems related to various mechanisms.

INTERNAL COMBUSTION ENGINES

Paper Code	**ME - 506**
Course Credits	**3**
No. of Lectures/ week	2
No. of Tutorials/week	1
Course Description	**Unit-I** I.C. Engines: Introduction and Engine classification; Major Applications; Air Standard Cycles and their Analysis ; S.I. and C.I. Engines operation; Working principles, merits and demerits of 2-Stroke and 4-Stroke engines ; Scavenging of Two Stroke Engines; Introduction of Supercharging & Turbo charging. **Unit-II** S.I. Engines: Introduction- Stages of Combustion in S.I Engines, Abnormal Combustion, Effect of Engine Variables on Knock; Fuel metering, Carburetion and Fuel injection systems. **Unit-III** C.I. Engines: Introduction- Stages of Combustion in C. I. Engines, Significance of Delay Period on Knocking phenomena, Influence of Various Factors on Delay Period, Comparison of Knock in SI and CI Engines. **Unit-IV** Gas Turbine & Jet Propulsion: Thermodynamics analysis of Actual Gas Turbine Cycle; Introduction of Turbojet, Turboprop, Turbofan, Ramjet and Rocket Engines. **Unit-V** Fuels: Fuels used in S.I., C.I. Engines & Gas Turbines, Non-conventional Fuels, its Fuel characteristics and their rating. Alternative Fuels. Exhaust Emissions from S.I& C I Engines & its Control.
Pre-Requisite Courses (/ Papers):	Applied Thermodynamics, Fluid Mechanics and Heat and Mass Transfer
Text books: **Reference books:**	• Internal Combustion Engine by V. Ganesan; Tata McGraw Hill Publication • Internal Combustion Engines Fundamentals by John B. Heywood; McGraw Hill • Internal Combustion Engines and Air Pollution, by Edward F. Obert Harper & Row Publishers • Internal Combustion Engine by Sharma &Mathur; DhanpatRai& Sons
Course Objective	• To impart knowledge and understanding of basic concept and working of different types of Engines. • To make the student capable enough to be employed by Engine Manufacturers.

Course Outcomes	CO1: Expanding the knowledge of different type of engines with working principles, merits and demerits CO2: Learning the stages of combustion for S.I engine and its thermodynamic analysis CO3: Detailed analysis of stages of combustion for C.I engine and fuel injection system CO4: Thermodynamic analysis of gas turbine and jet propulsion. CO5: Understanding the behaviour of fuel in various engines and turbines.
Computer Usage / Software required:	Dynomation-5; Engine simulation and other related software

Course Syllabi

B.Tech.(Mechanical Engineering)

SIXTH Semester

COMPUTER AIDED MANUFACTURING

Paper Code	**ME- 601**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/ week	1

Course Description

Unit-I

Introduction: Overview of automation in industry. Type of production: continuous, mass, batch and job shop and automation achievements therein. Concept of computer aided engineering. Product cycle and CAD/,CAM influence CAD/CAM on product cycle. Computer Aided Process Planning (CAPP), Material requirement planning (M.R.P)

Numerical Control: History of NC/CNC Machines. Numerical control and its basics. Coordinate system of NC machines Axis designation. NC motion control systems: point-to-point, straight-cut and continuous path control systems. Applications of NC in metal-cutting and non-metal cutting areas.

Unit-II

Computer numerical control: devices, drives and control circuits, PLCs,Block diagrams of CNC operations. Nomenclature, types and features of CNC machine tools. Elements of CNC machines and systems. Machine control unit. Position control and its significance.Engineering analysis of NC positioning systems. Open loop and closed loop systems. Precision in NC positioning systems: control resolution, accuracy and repeatability.Actuators: DC servomotor, ac servomotor, stepper motor. Transducers and feedback elements: resolvers, inductosyns optical grating and encoders.

Unit-III

Part programming:Introduction to Process planning and flow chart for part programming. Tooling systems, tool nomenclature and tool geometries of modern indexable carbide tools. Tool presetting& Modular Tooling. Selection of tools based on machining capacity, accuracy and surface finish. Elements of programming for turning and milling. NC code generationPreparatory codes G, Miscellaneous functions M. Interpolation, Tool compensations, cycles for simplifying programming. Part programming for typical components on turning machines and machining centres.

Computer aided programming: APT Part Programming. Introduction to computer aided programming through Pro-E.

Unit-IV

Modern CNC machines: CNC lathes. Turning centres. Machining centres. . Automatic pallet changers. Automatic tool changers. Direct numerical control and applications. CNC machine design features. Supporting structures. Guide ways. Ball screw-and-nut mechanisms. Machine spindles. Concept of rigidity and relation with accuracy.

Computer aided Inspection: Contact and non-contact sensingtechnologies, Introduction to machine vision and applications of optical inspection, Coordinate measuring machines and their applications.

	Unit-V Manufacturing Automation: Automation strategies, devices, drives and control circuits in automation, performances and analysis of manufacturing system. Fundamentals of Group technology (G.T), Material handling system: conveyors – AGVs, Industrial robots, Basics of FMS and CIM.
Pre-Requisite Courses (/ Papers):	Production Engineering, Computer Aided Design, Fundamental of Computers
Text books:	• Automation Production System and Integrated Manufacturing, Grover M. P., Prentice Hall of India, New Delhi. • CAD/CAM Principle and Application, PN Rao, Tata McGraw Hill PublishingCo. Ltd, New Delhi.
Reference books:	• Computer Integrated Design and Manufacturing, David D. Bedworth, McGraw Hill Inc. Singapore. • CAD/CAM", Grover M.P, "Prentice Hall of India, New Delhi.
Course Objective	Computer aided manufacturing is an interdisciplinary subject area. This course tries to build fundamentals and working knowledge of the subject.
Course Outcomes	CO1: Basic uses related to CAD/CAM systems and Computer Numerical Control. Type of production, Applications of NC in metal-cutting and non-metal cutting areas. CO2: Learn CNC and positioning systems, Elements of CNC machines and systems. Machine control unit. Actuators: DC servomotor, ac servomotor, stepper motor. CO3: Part programming, Tooling systems, tool nomenclature and tool geometries of modern indexable carbide tools. Introduction to computer aided programming through Pro-E. CO4: Concepts related to modern CNC machines. Computer aided programming: APT Part Programming. Computer aided Inspection CO5: Manufacturing automation and new developments in the area like FMS, CIM, GT and MRP.
Computer Usage / Software required:	Relevant industry and simulation software.

DESIGN OF MECHANICAL SYSTEM

Paper Code	**ME-602**
Course Credits	**3**
No. of Lectures/week	2
No. of tutorials/week	1

Course Description

Unit-I

Shafts: Stresses in shaft, kinds and causes of failure in shafts. Design calculation for strength and deflection. Design of short and line shafts. Fatigue consideration. Types of couplings. Design of muff and flange coupling. Materials for shafts.

Unit-II

Bearings: Rolling and sliding elements. Nomenclature of journal bearing. Lubrica¬tion in loaded journal. Non-dimensional characteristic numbers and their application in design. Heat generation transfer in journal bearing. Thrust bearings. Ball and roller bearings. Types of roller bearing types of ball bearing. Friction in following contact bearings. Equivalent static Load, basic static and dynamic load capacities. Life and selection of roller bearing.

Unit-III

Power Transmission Systems: Types of drives. Comparison. Mechanical drives and their characteristics. Belt drives and types. Design of belts for strength. Theory and design of belt drives. Velocity ratio. Flat belts. V-belts. Selection of belts and belt materials. Surface strength and against bending. Design o chain drives.

Unit-IV

Gear: Types of gears. Modes of gear failures. Force analysis for gears. Design of spur gear based upon contact stress. Beam strength of gear teeth. Lewis form factor and other factors affecting design of gear. Dynamic and static tooth load considerations. Design of spur gears based upon wear. Gear materials.

Unit-V

Design of Gear Drives: Introduction to Gear box, Structural Diagram, Sliding-Mesh Gearing. Design calculation for spur gear (Straight tooth and inclined tooth) reducers. Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.

Pre-Requisite Courses (/ Papers):	Machine Design-1, Mechanics of SolidandTheoryof Machines
Text books:	• Mechanical Engineering Design by J.E. Shigley, C.R. Mischke& R.G. Buyres. McGraw Hill Book co., 7 e. • Fundamentals of Machine Component Design by R.C. Juvinall, John Wiley &Sons.

Reference books:	• Design of Machines Elements by M.F. Spotts, Prentice Hall of India. • Machine Elements by V. Dobrovolsky, MIR Publishers, • Machine Design by Black and Adams, McGraw-Hill Book co. • Machine Component Design by William Orthwein, Jaico Publishing House. • Machine Design by A. Mubeen, Khanna Publication
Course Objective	•Reinforce the philosophy that real engineering design problems are open-ended. •Give practice in longer open-ended problems using design methodology Give practice in longer open-ended problems using design methodology •Broaden skills in team work, critical thinking, communication, planning and scheduling through design project
Course Outcomes	CO1: Detailed analysis of shaft and various factors for fatigue. CO2: Detailed study of bearings and their industrial uses. CO3: Understanding the concept of various types of power transmission system. CO4: Complete analysis of gears and its designing. CO5: Design of Gear Drives, Materials for gears standards for spur gears. Lubrication & efficiency of a gear drive.
Computer Usage / Software required:	CATIA, PRO-E

OPERATIONS RESEARCH

Paper Code:	**ME- 603**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/week	1
Course Description	**Unit-I** Introduction: Nature and development of operations research, general methodology of OR; applications of OR to industrial problems. Formulation of linear programming; deterministic models Linear Optimization Models: Graphical solutions. Introduction to LINDO, LINGO and related software for solving optimisation problems **Unit-II** Simplex algorithm, computational procedure in simplex, duality and its concept. Application of elementary sensitivity analysis Application of Linear Programming. Applications of simplex technique **Unit-III** Queuing Problems: Queuing systems and concepts; classification of queuing situations; Kendall's notation, solution of queuing problems, single channel, single stage, finite and infinite queues with Poisson arrival and exponential service time; applications to industrial problems. Transportation problems; methods for obtaining the solution, degeneracy in transportation problems. Stepping stone method. Trans-shipment problems. Assignment problems. **Unit-IV** Simulation: Introduction, reasons for using simulation, limitations of simulation. Steps in simulation process. Application of simulation. Computer simulation. Monte Carlo simulation. Sequencing, n jobs two stations, two jobs n stations and graphical method. Decision theory. **Unit-V** Network development, Gantt chart. Project Critical path scheduling, construction of a CPM network, the critical path. Float calculations. Project Evaluation and Review Technique and its calculations, Network applications in operations management. Project crashing and resource allocation. Newer Network methods. Mathematics I, II and III
Pre-Requisite Courses (/ Papers):	
Textbooks::	Operations Research – Introduction, Taha, H.A., Pearson Education, India

Reference books:	• Quantitative Techniques for Decision Making, Gupta M P, Prentice Hall of India. • Introduction to Operations Research by Hillier and Lieberman, Tata McGraw Hill, India
Course outcomes	• Introduction to operational research and its general methodology. Problem formulation and solution with graphical methods. • Understanding the simplex algorithm and its application in simple situations • Understanding the queuing system and concepts with basic numerical. Transportation and assignment model solutions • Introduction to simulation and its applications Decision making under uncertainty • Learning the basic knowledge of network development and project management with Project time management using CPM & PERT
Computer Usage / Software required:	MS Project 2000 (and Prima Vera), Operation research software like LINDO, LINGO, SOLVER SUIT, EXCEL etc.

REFRIGERATION AND AIR-CONDITIONING

Paper Code	**ME-604**
Course Credits	**3**
No. of Lectures/week	2
No. of tutorials/week	1

Course Description

Unit-I

The second law interpretation, Vapour compression cycle. Actual vapor compression cycle. Effect of Super Heating, the suction vapour, super-heating with useful cooling and super-heating, Liquid-Suction heat exchanger, removal Flash gas, Inter-cooling, Compound Compression with water inter-cooling, Compound Compression with liquid flash cooler.

Combination of multiple components in compound compression systems, Cascade systems.

Unit-II

Refrigerants: classification of refrigerants, Designation of refrigerants, Selection of refrigerant, required properties of an ideal refrigerant, Secondary refrigerants, Brine.

Absorption Refrigeration System: Simple vapour absorption system, Co-efficient of Performance of absorption systems. Lithium -Bromide- Absorption refrigeration system, Brief Study of Domestic Refrigerators, Solar Refrigeration, Reversed Brayton cycle.

Spray Ponds and cooling towers, and water treatment plant.

Unit-III

Refrigeration Equipment: Evaporators: flooded evaporators, liquid chiller, direct expansion coil, Heat transfer during boiling. Fluid side heat transfer, Overall performance.

Condenser: Air cooled condensers, water cooled condensers, heat transfer in condensers, Fouling Factor, water side co-efficient, superheating, Finned tubes air cooled and evaporative condenser.

Expansion Devices: Automatic or constant pressure expansion valve, thermostatic Expansion valves. Capillary tube and its sizing.

Types of Compressors, Selection of Compressors for Refrigeration systems.

Unit-IV

Air-conditioning: Psychrometry, Definition of Psychometric properties, Psychrometric relations, Psychrometric chart, Psychrometric processes, Thermodynamicwetbulbtemperature, Calculation of air properties, Summer air-conditioning system for hot and dry outdoor conditions and for hot and humid air conditions, winter air-conditioning system, Year round air-conditioning system.

Unit-V

Requirement of comfort air Air-conditioning: Effective temperature economic consideration for selecting the comfort point, Cooling load calculation; sum load,

	Load from occupants, equipment load, Infiltration air load, fan load, fresh air Load. Design of air-conditioning systems, Cooling load and air quantities, Central air-conditioning system, and unitary air-conditioning system, Comfort indices, Control, Duct design
Pre-Requisite Courses (/ Papers):	Thermodynamics, Heat Transfer, & Fluid Mechanics.
Text books:	Refrigeration and Air-conditioning by C.P. Arora, McGraw-Hill.
Reference books:	• Fundamental of Refrigeration by Dossat – McGraw Hill • Refrigeration and Air-conditioning by P.L. Ballaney, Khanna. Publication
Course Objective	• Clear all concepts of Refrigeration Cycles • Clear all concepts of Heating, Ventilation and Air-conditioning systems and cycles • Introduce to Green, Intelligent Buildings • Train students to work as an HVAC Engineer.
Course Outcomes	CO1: Introduction of Refrigerating machines and multi-pressure systems. CO2: Understanding the classification and selection of refrigerants and condensers. CO3: Learning various refrigeration equipment's. CO4: Introduction to basic concepts of air-conditioning. CO5: Understanding the requirement of comfort air-conditioning
Computer Usage / Software required:	• Students can be introduced to basic simulation software such as Fluent; HEVACOMP, Primavera, and other CFD modelling techniques.
Other details regarding this course (if any)	• HVAC is a big industry & student has prospects of becoming Design Engineer; Site Engineer; Procurement Engineer; Project Engineer etc.;

TURBO-MACHINES

Paper Code	**ME-605**
Course Credits	**3**
No. of Lectures/week	2
No. of tutorials/week	1

Course Description

Unit-I

Fundamentals of Turbomachines: Introduction, fluid machines, turbomachines, classification of turbomachines, basic laws and equations, Euler's equation for a turbomachine, velocity triangles, slip, steady flow energy equation, degree of reaction, impact of jets, aerodynamics of turbomachinery blading, losses in turbomachines.

Dimensional Analysis and Model Testing: Buckingham's π theorem, significant dimensionless groups in turbomachinery, incompressible and compressible flow turbomachines, flow similarity and model studies, specific speed, unit quantities, thermodynamics of fluid flow; stagnation and static properties, problems.

Unit-II

Hydraulic Turbines: Introduction, schematic layout of a hydro-electric power plant, Euler's equation for hydro-turbines, efficiencies of hydraulic turbine, classification of hydraulic turbines; impulse and reaction turbines, working and analysis of **Pelton, Francis, Kaplan and Propeller turbines,** draft tube, specific speed, cavitation in turbines, performance characteristics of turbines, governing of turbines, comparison of turbines, selection of hydraulic turbines, problems.

Unit-III

Hydraulic Pumps: Introduction, classification, **centrifugal pump;** working, priming, head developed, losses and efficiencies, theoretical head vs. discharge curve, velocity triangles, slip, effect of blade outlet angle on head vs. discharge characteristics, specific speed, performance characteristics, net positive suction head (NPSH) and cavitation, pumps in series and parallel, problems, **axial flow pump;** working principle, performance characteristics, centrifugal vs. axial flow pumps.

Unit-IV

Compressors, Fans and Blowers: Introduction, classification, **centrifugal compressor;** working principle, velocity triangles, slip factor, power input factor, specific work and pressure rise, losses and efficiencies, T-s diagram, non-dimensional quantities, performance characteristics, surging, choking and rotating stall, problems. **axial flow compressor;** description and principle of operation, stage velocity triangles, losses and efficiencies, T-s/h-s diagram, pressure ratio per stage, work done factor, flow coefficient, degree of reaction, performance characteristics, centrifugal vs. axial flow compressors, problems. **Fans and Blowers;** terminology, difference between a fan, blower and a compressor, classification, velocity triangles, losses, performance characteristics.

Unit-V

Gas Turbines: Introduction, Joule-Brayton cycle, classification; axial and radial flow turbines, velocity triangles and T-s diagram, performance characteristics, **propulsive devices;** turbojet, turboprop, bypass turbojet engines, thrust augmentation, problems.

Unconventional Turbomachines: wind turbines, solar turbines etc.

Pre-Requisite Courses:	Fluid Mechanics –I and II, Applied Thermodynamics

Text books:	Shepherd, D. G., Principles of Turbomachinery, Macmillan.
Reference books:	• Cherkassky, V. M., Pumps, Fans and Compressors, Mir Publishers, • Yahya, S. M., Turbines, Fans and Compressors, • Douglas, J.F., Gasiorek, J.M., Swaffield, J.A., and Jack, L.B., Fluid Mechanics, Pearson Education, Ltd. • Sayers, A.T., Hydraulic and Compressible Flow Turbo machines, McGraw Hill, 1990. • Saravanamuttoo, HIH. Cohen, H., Rogers, GFC. Gas Turbine Theory, Pearson Education, Ltd. • Wright, T., Fluid Machinery: Performance, Analysis and Design, CRC Press, • Lefevre, A. H., Gas Turbine Combustion, Taylors & Francis
Course Objective	To provide basic understanding of working and associated principles of Turbo Machines. This includes turbines, compressors, pumps, blowers, fans and other associated devices.
Course Outcomes	CO1: learning definitions and basic principles of turbo machine. CO2: Learning classification, principles of operation and related uses of hydraulic pumps. CO3: Learning classification, principles of operation and design of different types of hydraulic turbines. CO4: Understand the working of compressors, fans and blowers. CO5: learning basic principles of gas turbines. Wind turbines and Propellers; Fluid couplings and torque converters; Unconventional turbo machines
Computer Usage / Software required:	e.g. MATLAB, EXCEL, EES, Fluent, STAR-CD etc.

Course Syllabi

B.Tech.(Mechanical Engineering)

SEVENTH Semester

MECHANICAL VIBRATIONS

Paper Code	**ME-701**
Course Credits	**3**
Lectures/week	2
Tutorials/week	1
Course Description	**Unit-I** **Free vibrations of single degree of freedom systems:**Importance of the study of vibration, basic concepts of vibration, classification of vibration, vibration analysis procedure, free vibrations of undamped and damped,translational& torsional, single degree of freedom systems, derivation and solution of equations of motion using different methods. free vibration with viscous damping, coulomb damping and hysteretic damping. **Unit-II** **Forcedvibrations of single degree of freedom systems:**response of an undamped system underharmonic force, response of a damped system under harmonicforce, response of a system under the harmonicmotion of the base, response of a damped system under rotatingunbalance, transfer-function approach, solutions using Laplace Transforms. **Unit-III** **Free and forced vibrations of two degree of freedom systems**: Derivation and solution of equations of motion using different methods, Free& forced Vibration Analysis of damped and undampedSystem, Coordinate Coupling and PrincipalCoordinates, Semi-definite Systems, vibration absorbers. **Unit-IV** **Free and forced vibrations of multi degree of freedom systems**: Modeling of continuous systems as multidegreeoffreedom systems, derivation of equations of motion using influence coefficients, Lagrange's equations, generalized coordinates and generalizedforces, Eigenvalue problem, solution of the eigenvalue problem, free vibration of undampedsystems, forced vibration of undamped systemsusing modal analysis. **Unit-V** **Approximate methods for determination of natural frequency of multi degree of freedom systems:**Dunkerley'sMethod, Rayleigh's Method, Holzer's Method, Matrix Iteration Method, Jacobi's Method, Standard Eigenvalue Problem. **Simple cases of continuous systems**:Transverse vibration of string, longitudinal vibration of bar, torsional vibration of shaft or rod, lateral vibration of beams.Whirling of shafts.

Pre-Requisite Courses (/ Papers):	Theory of Machines, Machine Dynamics, Engineering Mathematics
Text books:	• Mechanical Vibrations (Sixth Edition in SI Units) by Singiresu S. Rao, Pearson Education, 2018 • Mechanical Vibrations by G.K. Grover, Nem Chand Bros. Roorkee. • Theory of Mechanisms & Machines by A. Ghosh & A. K. Mallik, EWP
Reference books:	• Mechanical Vibrations, Theory and Applications by S. Graham Kelly, Cengage Learning. • Schaum's Outline of Theory and Problems of Mechanical VibrationsbyS. Graham Kelly,McGraw Hill • An Introductory course on Theory & Practice of Mechanical Vibrations by J.S. Rao & K. Gupta, Wiley Eastern Ltd. • Elements of Mechanical Vibrations by William P. Thomson Prentice Hall, India.
Course Objectives	• Understand undamped SDOF systems and its relation to a vibrating system • Understand Damped SDOF systems-viscous (underdamped, critically damped and overdamped) and coulomb friction, their differences and relation to real world • Understand Forced Motion due to harmonic loading and rotating unbalance • Understand the concept of lumped parameter analysis to represent a system as a set of masses, springs and dampers to evaluate the vibration characteristics of the system.
Course Learning Outcomes	• Understand the basic concepts of mechanical vibrations, modelling and analysis of free damped and undamped SDoF systems. • Understand the response of the forced damped and undamped SDoF systems • Understand the response of the forced damped and undamped two DoF systems andprinciple of vibration absorption &isolation. • Analyse multi-degree of freedom systems, Apply Eigenvalue analysis to the solution of vibration problems. Apply the concept of modal analysis. • Understand the approximate methods for finding natural frequencies of MDoF systems and Model and analyse continuous systems.

INDUSTRIAL ENGINEERING

Paper Code	**ME-702**
Paper Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-I

Contribution of Industrial engineering in everyday life, Definition and scope of Industrial engineering, somoe historical developments. Production and production systems. Role of Innovation and disruptive innovation in development of industrial engineering. The general problem solving approach. Systems approach in problem identification and solving, brief of some other methods. Productivity, Manufacturing process technology and its relevance, site location and factors affecting site location. Plant location and capacity planning design and assembly ine balancing

Unit-II

Motion and Time Study, definition, importance, limitations & historical background, Process Analysis through charts: Process chart, activity charts, man & machine charts and operation process charts.Motion study: Motion analysis, camera study, micro motion study, cyclograph and chronocyclograph. Fundamental hand motions. Principles of motion economy and human body, arrangement of workplace in respect of tools and equipment. Micro motion Study, SIMO Charts. Time Study: Stopwatch time study: Information recording, data recording by continuous, repetitive and cumulative timing, determining number of observations, the rating factor, performance rating, allowances determination, normal and standard time.Work sampling: theory, procedures, and applications. Synthetic time and introduction to predetermined times

Unit-III

Inventory: reasons of holding inventory, Inventory concepts, inventory costs and Inventory models assuming certainty. Inventory management. ABC and related analysis Inventory models with safety stock Material Requirement Planning (MRP) Introduction to Enterprise Resource Planning. Just in Time Systems Supply Chain Management and critical chain Material Handling &Reliability

Unit-IV

Quality: evolution of Quality concepts in industry, historical perspective, definition. Importance to services and manufacturing. Basic quality related concepts. Quality dimensions. Economics of quality, quality is free. Acceptance sampling plans by attributes, Operating Characteristic Curve, producing and consuming risks.Single, double and sequential sampling plans. Acceptance sampling by variables. Average outgoing quality.Limitations and importance of Sampling plans

	Unit-V Quality Management, Quality Circle. Quality Systems. Seven Quality control tools. Control charts for variables. Control chart for attributes. Total Quality Management I. Business Process Redesign and Breakthrough improvements.
Pre-Requisite Courses (/ Papers):	Operation Research, Engineering Economy and Management.
Text books:	• Motion and Time Study Design and Measurement of Work", Ralph M. Barnes, John Wiley & Sons. New York. • Introduction to Statistical Quality Control, Douglas C. Montgomery, John Wiley & Sons. New York
Reference books:	• Martinich, Joseph S, "Production and Operations Management: An Applied Modern Approach," John Wiley, Re. Ed
Course Objective	Industrial Engineering has evolved and established itself as a branch of engineering. A basic overview of different areas covered in this branch of engineering is provided.
Course Outcomes	• Introduction to Industrial engineering with systems approach and productivity. Process structure, layout, capacity planning, location, balancing. • Time and motion study basics and applications • Inventory concepts, costs, basic models. Inventory management for dependent and independent demand. Just in Time, ERP and Supply Chain Management. • Quality concept, definition application and Economics. Quality control by Acceptance sampling both for attributes and variables • Control charts for both variable and attributes, concept of TQM, its principle, tools and new developments.
Computer Usage / Software required:	• E.g. EXCEL and other Industrial Engineering Software.
Other details regarding this course	This course is of predominantly important in industry and needs lots of industrial visits and awareness of what best practices are being followed.

AUTOMOBILE ENGINEERING

Paper Code	**ME-703**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	1

Course Description

Unit-I

Components of Automobile and their compositions, Power unit, General layout of automotive vehicle, Engine performance characteristics, Turbo charging and supercharging, Multi cylinder engines and their arrangements, Firing order

Unit-II

Rolling, air or wind and gradient resistance, Power requirement, Matching of engine power with demand power, Tractive effort, Vehicle performance, Gear Box and types of Gear box, Relationship for two and four-wheel vehicles.

Unit-III

Power transmission, Clutch and its types, Gear boxes—Sliding mesh, constant mesh, synchromesh and epicyclic arrangements, Propeller shaft, universal joint, Differential , Live axle, Floating and full floating axle system.

Unit-IV

Steering system, steering geometry, Types of steering mechanisms: Ackerman steering mechanism, Davis steering mechanism, steering linkages, power steering. Tyres and its types, specifications and construction, tyres ground contact area, material and disposal of tyres.

Unit-V

Suspension system, types of suspension system—Rigid axle suspension system, torsion bar, Independent suspension system, shock absorbers.
Braking system, mechanical braking system, disc and drum brakes, hydraulic brakes, master cylinder, Brake fluid and its properties, Weight transfer during braking and stopping distances.

Pre-Requisite Courses (/ Papers): Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Text books:

- The motor vehicle by K. Newton, W. Steeds and T. K. Garret, ESBS Publications

Reference books:

- Automobile Engineering by G. B. S. Narang
- Automotive Mechanics—Principles and practices by HeitnerJoseph , East-West Press
- Automobile Engineering, Kirpal Singh, Standard Publishers
- Automotive Chassis, by P.L. Kohli, Papyrus publications
- Auto mechanics, by Michell, McGraw Hill Publications.
- Automobile Engineering by S K Gupta, S Chand publisher
- Automobile Engineering by D S Kumar, S K Kataria and Sons.

	• Automotive Technology, Heinz and Hizler, ELBS Edition
Course Objective	• To develop an understanding of basics of an automobile function. • To make students competent enough to be absorbed in automobile industries.
Course Outcomes:	CO1: Introduction to components of automobile and their composition. CO2:Learning the concepts of rolling with various resistance gradients and developing relationship between two and four-wheel vehicles. CO3: Understanding the concepts of power transmission. CO4: Learning the concepts of steering system. CO5: To learn about suspension systems; braking systems.
Computer Usage / Software required:	Relevant Industry software
Other details regarding this course	This course is of predominant importance in automobile engineering and its Indian perspective for Mechanical Engineering.

ENERGY SOURCES

Paper Code	**ME-704**
Course Credits	**3**
No. of Lectures/week	**2**
No. of tutorials/week	1

Course Description

Unit-I

Introduction: Sources of conventional and renewable energy, Trends of energy consumption, Fossil fuel availability and limitations, Need to develop new energy sources. Energy Economy.Various Terms and definitions, load curves, cost of electricity generation, performance and operating characteristics.

Unit -II

Steam Power Plant: General layout of steam power plant, site selection, coal burning methods, disposal of ash and dust, combined cycle power plants, integrated coal gasification, major plant components: Super heaters, Re-heaters, Economizers, Air Pre-heaters condensers, cooling towers.

UNIT-III

Hydro-electric Power Plant: Classification, layout, components and auxiliaries of hydro power plant, Selection of turbines, micro hydro plants, pumped storage.

Solar Energy: Solar radiation, characteristics and estimation, Solar Collectors, Flat Plate concentrating types; Their comparative study, Direct Conversion of Solar energy to electricity.

Unit-IV

Principles of release of nuclear energy Fusion and fission reactions. Nuclear fuels used in the reactors. Nuclear Power Plants: Location, component of nuclear plants, Elements of the Nuclear reactor; Moderator, control rod, fuel rods, coolants. Description of reactors of the following types - Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards and Radioactive waste disposal.

Unit-V

Wind Energy: Wind turbines and their characteristics; Types of rotors, horizontal axis and vertical axis systems, system design, site selection and Performance analysis.

Tidal Energy: Sites, potentiality and possibility of harnessing from site, limitations.

Geo-thermal Energy: Sites, potentiality and limitation, study of different conversion systems.

Ocean Energy: Principle of utilization and its limitations, description of various systems. Biomass Systems: Biomass conversion – Combustion, gasification, Energy from waste and other sources.

Pre-Requisite Courses	Fluid Mechanics I&II, Applied Thermodynamics, A.T.H.T
Text books:	• G.N. Tiwari & S. Suneja: Solar Thermal Energy Systems, Narosa Publishing House
Reference books:	• S.P. Sukhatme: Solar Energy – Principles of Thermal Collection & Storage, Tata McGraw Hill. • H.P. Garg: Advances in Solar Energy Technology, D. Reid Publishing House • A.N. Mathur and N.S. Rathore: Biogas Production, Management and Utilization, Himansu Publications. • K.C. Khandelwal& S.S. Mandi: Practical Hand Book of Biogas Technology
Course Outcomes	CO1: understand functions of the components of power plant. CO2: understand the working of nuclear, thermal and oil based power plants. CO3: Evaluate the design layout and working of hydro electric power plants. CO4: Evaluate economic feasibility and its implication on power generating units.

Course Syllabi

B.Tech.(Mechanical Engineering)

EIGHT Semester

ROBOTICS

Paper Code	**ME-801**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	**1**
Course Description	**Unit-I** **Fundamentals of Robotics:** Introduction, Automation and Robotics, A Brief History of Robotics, Laws & Definition of Robot Anatomy & Classification of Robots, Human system & Robotics, Specifications of Robot, Work Volume, Precision of Movement. The Robotics Market, Social Issues and the Future Prospects. **Unit-II** **Robot Arm Kinematics:** Introduction to Robot Arm Kinematics, Homogeneous Coordinate transformations, Direct & Inverse Kinematics, Composite Homogeneous transformation matrix. Link, joint and parameters. DenavitHarten Berg Notation, D-H Matrix, Kinematic equations. Exercises on Direct & Inverse Kinematics up to six degree of freedom Robots. **Unit-III** **Robot Grippers:** Classification of End Effectors, Mechanical Grippers, Magnetic gripper, Vacuum gripper, Adhesive gripper, Multifingered gripper - Utah, Okada, Stanford, DGIT Hands. Considerations in Gripper Selection - Force Analysis and Design. **Unit-IV** **Robot Drives, Sensors, Actuators and Control:** Robot drive systems-Hydraulic, Pneumatic & Electric. Robot Sensors - Contact & noncontact type sensors, Force & torque Sensor. Robotic vision system. Basic Control Systems Concepts and Models, Controllers, Control System Analysis. **Unit-V** **Robot Programming-Languages & Applications in Manufacturing.** Methods of Robot Programming, Lead through Programming Methods. Robot Languages & classification. Programming Exercise on ACL/ATS for Robots EshedRobots . Robot Application areas- Material Transfer and Machine Loading/ Unloading, Processing Operations, Assembly and Inspection**,** Future Manufacturing Applications Robots.
Pre-Requisite Courses (/ Papers):	Kinematics & Dynamics of Machines, Instrumentation & Control Engineering.

Text books:	1. "Robotics" by S.K.Saha,Tata *McGraw-Hill Pvt.Ltd.* 2. .Industrial Robotics" by M.P Groover, *McGraw-Hill International Editions.*
Reference books:	1. "Introduction to Robotics": by J.J Craig., Addison Wesley N Delhi. 2. "Robotics" by K.S.Fu., *McGraw-Hill International Editions.*
Course Objective	To provide an introduction to Robotics including robot classification, design and selection, analysis, sensing and control, and applications in industry.
Course Outcomes:	CO1: Introduction of fundamentals of robotics and automation. CO2: Understanding the concepts of robot arm kinematics and its applications. CO3: Learning the concepts of robot grippers and its classifications. CO4: Understanding the working of robot drives, sensors, actuators and control. CO5: Learning the robot programming language and its applications in manufacturing.

ERGONOMICS

Paper Code	**ME-830**
Course Credits	**3**
No. of Lectures/week	2
No. of Tutorials/week	**1**

Course Description

Unit-1

Introduction to ergonomics, scope of ergonomics, cost of ignoring ergonomics, result of application of ergonomics, Ergonomics and its areas of application in the work-system, Description of Human-Machine system. Standard format for describing human-machine system.

Unit-II

Muscular Work: Physiological Principles, Sources of Energy, Nervous control of movements and structure of nervous system: Types of nervous system, Neurons, Action potential, Sodium potassium pump, innervations of muscles, Reflex-arc. Dynamics and static muscular work. Field method for assessing physical overload.

Unit-III

Introduction to Anthropometry, Its application in design of system, Design aspect in ergonomics: Manufacturing work-station design; Determining work-station design parameters, Systematic approach for determining work-station design, determining work-station dimension. Tool evaluation and design: Principles of tool design (General principles, Anatomical concern, and Single handle); Attributes of common industrial hand tools, Attributes of common industrial power tools, Tool evaluation check list. Displays and controls.

Unit-IV

Cumulative Trauma Disorder: Work-related Musculoskeletal Disorder: Definition of work-related Musculoskeletal Disorder, Types of WMSDs, Factors affecting WMSDs. Occupational Human Vibration: Characteristics of vibration, Whole-body and hand-arm vibration, Effect of vibration on comfort, health and performance.

Unit-V

Sound and related studies: Definition, evaluation of noise, combining decibels. Levels and Spectra: Sound power level, sound intensity level, numerical problems on sound its measurement, Illumination and its measurement.

Pre-Requisite Courses (/ Papers): Industrial Engineering

Text books:

- Introduction to Ergonomics-R.S. Bridger, McGraw-Hill International Edition.

Reference books:

- Industrial Noise Control-Lewis H-Bell and Douglas H-Bell, Marcel Dekker, INC.
- Fitting Tasks to Human, Kroemer, K.H.E. and Grandjean, E. (1997).

	Philadelphia: Taylor and Francis • The Ergonomic Edge-MacLeod, D. (1995). New-York: Van NostrandReinhold.
Course Objective	• Provide students with the basis of occupational ergonomics. • Ergonomic considerations in design, ergonomic consideration in re-design and research basis of ergonomics.
Course Outcomes	CO1: Understand the fundamental of ergonomics (Human Factors) principles of design and evaluation. CO2: Be able to describe an expanded view of ergonomics, which encompasses more than ergonomically related injuries but all parts of assuring that the work-place fits the worker. CO3: Be able to put ergonomic assessments and solutions to practical use in the work place. CO4: Will be capable of initiating evaluations of ergonomic issues and working with an ergonomist. CO5: Understanding the concept of Sound and related studies, Numerical problems on sound its measurement
Computer Usage / Software required:	Adobe Acrobat Reader, Power Point or PP viewer, Video Player.

PRODUCT DESIGN

Paper Code	**ME-814**
Course Credits	**4**
No. of Lectures/week	3
No. of Tutorials/ week	1
Course Description	**Unit - I** Significance of product design, product design and development process, sequential engineering design method, the challenges of product development. Introduction to AM Theory of inventive problem solving (TRIZ): Fundamentals, problem Solution, methods and techniques, General Theory of Innovation and TRIZ, Identifying Customer needs: Gather raw data from customers, interpret raw data in terms of customer needs, organise the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications **Unit - II** Concept Generation: The activity of concept generation clarifies the problem, search externally, search internally, explore systematically, and reflect on the results and the process.Concept Selection: Overview of methodology, concept screening, and concept scoring. Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, and reflect on the results and the process. **Unit - III** Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Design of Modular System – abstract design. The process of conception and its documentation **Unit – IV** Computer-aided design (CAD), need for CAD, components of CAD systems, advantages. Various design tools in product development, product development process stages, QFD, concurrent engineering.Value engineering Applications in Product development and design, Model-based technology for generating innovative ideas. 3D scanner: its types with scanning principle, applications.Overview of Steinbichler blue light 3D scanner, different components function and working principle. Rhinoceros 3D software, **Unit – V**

	Differentiate Additive manufacturing from subtractive manufacturing. Step used to create a 3D model. Different technologies used in additive manufacturing technologies like Stereolithography (SLA), Selective laser sintering (SLS), Fused deposit modeling (FDM), Selective Laser Melting (SLM), Laminated Object Manufacturing (LOM), Direct Metal Laser Sintering (DMLS), Inkjet Printing (IJP), Polyjet 3D printing, binding jet 3D printing, Built mechanism of each technology, applications. Overview of Colour-Jet 3D Printing (CJP), working principle, the material used, post processing in CJP. Project, seminar and exercises related to the above topics
Pre-Requisite Courses (Papers):	Production Engineering, Industrial Engineering, Computer Aided Design, Basics of Machine Design
Textbooks:	• Product Design and Development, Karl. T. Ulrich, Steven D Eppinger, Irwin Mc Graw Hill-
Reference books:	• Product Design, Pearson Engineering of creativity: an introduction to TRIZMethodology of Inventive Problem Solving, By Semyon D. Savransky, CRC Press. • Inventive thinking through TRIZ: A practical guide; By Michael A. Orloff, Springer. • Systematic innovation: An introduction to TRIZ; (theory of inventive Problem. • Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, “ • Product Design: Fundamentals and Methods, Roozenburg and Eekels, Publisher: McGraw-Hill • Design Secrets: Products: 50 Real-Life Projects Uncovered - Industrial Designers, Goodrich, Kristina; Society of America, Publisher: Rockport Publishers June 2001 • Creating Breakthrough Products: Innovation from Product Planning to Program Approval, Cagan, Jonathan; Vogel, Craig M, Publisher: Financial Times Prentice Hall; 2002
Course Objective	This is an interdisciplinary subject area. This course tries to build fundamentals and working knowledge of product design.
Course Learning Outcomes	Students will be able to learn the following • Acquire knowledge and essential skill regarding product design and development. TRIZ and its importance, Identifying Customer, needs towards product design • Concept generation and concept testing with the purpose • Product architecture, Design of modular system – abstract design. The process of product conception and its documentation • 3D scanning and its usage for product design and development, Product design tools like Value Engineering and QFD • Study different types of important3D printingtechnologieswith usage. Learning the operation of a Projet 3D Printing machine

Computer Usage / Software required:	Relevant software on scanning, inspection, reverse engineering, FEA and multi-body analysis needs to be practised.
Other details regarding this course	Product design is being taught through the foundation of theory and also engaging students in loosely supervised practice and industry exposure.