Scheme & Syllabi

For

B.Tech. (Mechanical Engineering)

Department of Mechanical Engineering
Guru Jambheshwar University of Science & Technology,
Hisar

Scheme for B.Tech. (Mechanical Engineering)

FIRST SEMESTER

CODE	Subject	L	T	P	CREDIT
HUM-101-E	Essentials of Communication	3	1	-	3.5
MATH-101-E	Mathematics -I	3	2	-	4.0
PHY-101-E	Physics-I	3	1	-	3.5
CH-101-E	Chemistry	3	1	-	3.5
EE-101-E	Electrical Technology	3	1	-	3.5
ME-105-E	Engineering Graphics & Drawing	1	-	4	3.0
CH-103-E	Chemistry Lab	-	-	2	1.0
EE-103-E	Electrical Technology Lab	-	-	2	1.0
PHY-103-E	Physics Lab - I	-	-	2	1.0
				TOTAL	**24.0**

SECOND SEMESTER

CODE	Subject	L	T	P	CREDIT
HUM-102-E	Communication Skills in English	3	1	-	3.5
MATH-102-E	Mathematics -II	3	2	-	4.0
PHY-102-E	Physics-II	3	1	-	3.5
CSE-101-E	Fundamentals of computers & programming C	3	1	-	3.5
ME-103-E	Manufacturing processes	4	-	-	4.0
ME-101-E	Elements of Mechanical Engineering	3	1	-	3.5
ME-109-E	Elements of Mechanical Engineering Lab	-	-	2	1.0
PHY-104-E	Physics Lab - II	-	-	2	1.0
CSE-103-E	Computer Lab	-	-	2	1.0
ME-107-E	Workshop practice	-	-	4	2.0
				TOTAL	**27.0**

Total Credits=51

THIRD SEMESTER

CODE	**Subject**	**L**	**T**	**P**	CREDIT
MATH-201-E	Mathematics -III	3	2	-	4.0
HUM-201-E	Economics	3	1	-	3.5
ME-201-E	Thermodynamics	3	1	-	3.5
ME-203-E	Strength of Material - I	3	1	-	3.5
ME-205-E	Engineering Mechanics	3	1	-	3.5
ME-207-E	Machine Drawing	1	-	4	3.0
EE-213-E	Electronics Engineering	3	1	-	3.5
ME-209-E	Strength of Material Lab - I	-	-	2	1.0
EE-219-E	Electronics Engineering Lab	-	-	2	1.0
ME-211-E	Computer Aided Drafting Lab	-	-	2	1.0
ME-213-E	Manufacturing Practice	-	-	3	1.5
				Total	**29.0**

FOURTH SEMESTER

CODE	**Subject**	**L**	**T**	**P**	CREDIT
HUM-202-E	Fundamentals of Management	3	1	-	3.5
ME-202-E	Manufacturing Technology	3	1	-	3.5
ME-204-E	Material Science	3	1	-	3.5
ME-206-E	Strength of Materials II	3	1	-	3.5
ME-208-E	Fluid Mechanics	3	1	-	3.5
ME-210-E	Energy Conversion	3	1	-	3.5
ME-212-E	Material Science Lab	-	-	2	1.0
ME-214-E	Fluid Mechanics Lab	-	-	2	1.0
ME-216-E	Energy Conversion Lab	-	-	2	1.0
UCC 581	*Environmental Studies	4	-	-	-
				TOTAL	**24.0**

*** Environmental Studies will be of qualifying nature.**

Total Credits=53

FIFTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-301-E	Kinematics of Machines	3	1	-	3.5
ME-303-E	Machine Design-I	3	1	-	3.5
ME-305-E	Fluid Machines	3	1	-	3.5
ME-307-E	Internal Combustion Engines & Gas Turbnes	3	1	-	3.5
ME-309-E	Manufacturing Sciences	3	1	-	3.5
ME-311-E	Applied Numerical Techniques& Computing	3	1	-	3.5
ME-313-E	Kinematics of Machines Lab	-	-	2	1.0
ME-315-E	Fluid Machines Lab	-	-	2	1.0
ME-317-E	Internal Combustion Engines & Gas Turbnes Lab	-	-	2	1.0
ME-319-E	Applied Numerical Techniques& Computing Lab	-	-	2	1.0
ME-321-E	Practical Training-I	-	-	2	1.0
				TOTAL	**26.0**

SIXTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-302-E	Dyanamics of Machines	3	1	-	3.5
ME-304-E	Machine Design-II	3	1	-	3.5
ME-306-E	Heat Transfer	3	1	-	3.5
ME-308-E	Automatic Controls	3	1	-	3.5
ME-310-E	Measurements & Instrumentation	3	1	-	3.5
ME-312-E	Industrial Engineering	3	1	-	3.5
ME-314-E	Dyanamics of Machines Lab	-	-	2	1.0
ME-316-E	Heat Transfer Lab	-	-	2	1.0
ME-318-E	Measurements & Instrumentation Lab	-	-	2	1.0
ME-320-E*	Professional Practices(Proficiency)*	-	-	-	0.0
				TOTAL	**24.0**

indicates Non-Credit paper, not counted towards calculation of SGPA/CGPA/Total Marks.

Total Credits=50

SEVENTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-401-E	Automobile Engineering	3	1	-	3.5
ME-403-E	Refrigeration&Air-conditioning	3	1	-	3.5
ME-405-E	Operation Research	3	1	-	3.5
ME-415-E	Mechanical Vibrations	3	1	-	3.5
ME (Refer to list attached)	Department Elective-I*	3	1	-	3.5
ME-407-E	Automobile Engineering Lab	-	-	2	1.0
ME-409-E	Refrigeration&Air-conditioning Lab	-	-	2	1.0
ME-411-E	Project (Starts)		-	4	2.0
ME-413-E	Practical Training-II	-	-	3	1.5
				TOTAL	**23.0**

EIGHTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-402-E	Computer Aided Design & Manufacturing (CADM)	3	1	-	3.5
ME-404-E	Power Plant Engineering	3	1	-	3.5
ME (Refer to list attached)	Department Elective-II	3	1	-	3.5
ME (Refer to list attached)	Department Elective-III	3	1	-	3.5
ME-408-E	Computer Aided Design & Manufacturing (CADM) Lab	-	_	2	1.0
ME-410-E	Independent Study Seminar	-	-	4.0	2.0
ME-412-E	General Fitness for the Profession*	-	-	2.0	1.0
ME-414-E	Project-II	-	-	10	5.0
				TOTAL	**23.0**

TOTAL CREDITS OF ALL SEMESTERS = 200

Department Elective – I*

L	T	P	Credit
3	1	----	3.5

Seventh Semester

CODE	Subject	L	T	P	CREDIT
ME 451 E	Finite Element Methods	3	1	-	3.5
ME 453 E	Energy Management Principles	3	1	-	3.5
ME 455 E	Engineering Design	3	1	-	3.5
ME 457 E	Computer Integrated Manufacturing	3	1	-	3.5
ME 459 E	Manufacturing Management	3	1	-	3.5
ME 461 E	Reliability Engineering	3	1	-	3.5
ME 463 E	Solar Energy Engineering	3	1	-	3.5
ME 465 E	Design of Heat Exchangers	3	1	-	3.5
ME 467 E	Value Engineering	3	1	-	3.5

Department Elective – II

L	T	P	Credit
3	1	----	3.5

Eighth Semester

CODE	Subject	L	T	P	CREDIT
ME 452 E	Optimization Methods for Engineering Systems	3	1	-	3.5
ME 454 E	Machine Tool Design	3	1	-	3.5
ME 456 E	Total Quality Control	3	1	-	3.5
ME 458 E	Pumps, Fans, Blowers & Compressors	3	1	-	3.5
ME 460 E	Design of Air-conditioning Systems	3	1	-	3.5
ME 462 E	Computer Aided Vehicle Design	3	1	-	3.5
ME 464 E	Mechatronics	3	1	-	3.5
ME 466 E	Flexible Manufacturing System	3	1	-	3.5
ME 468 E	Non-conventional Energy	3	1	-	3.5

Department Elective – III

L	T	P	Credit
3	1	----	3.5

CODE	Subject	L	T	P	CREDIT
ME 482 E	Maintenance Engineering	3	1	-	3.5
ME 484 E	Robotics Engineering	3	1	-	3.5
ME 486 E	Ergonomics and Work Place Design	3	1	-	3.5
ME 488 E	Modern manufacturing Process	3	1	-	3.5
ME 490 E	Cryogenics Engineering	3	1	-	3.5
ME 492 E	Entrepreneurship	3	1	-	3.5
ME 494 E	Facilities Planning	3	1	-	3.5
ME 496 E	Gas Turbine & Jet Propulsion	3	1	-	3.5
ME 498 E	Emerging Automotive Technologies	3	1	-	3.5

Eighth Semester

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

Program Educational Objectives (PEOs)

PEO1	Apply technical skill and professional knowledge in engineering practices to face industrial challenges around the world.
PEO2	To prepare the students to lead a successful career in industries or to pursue higher studies or to support entrepreneurial endeavors.
PEO3	Inculcate effective team work, ethics, and leadership with ability to solve societal problems.

Programme Outcomes (POs)

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify**,** formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage:** Create**,** select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice.
PO9	**Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
P10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Lifelong Learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1: To prepare the students to understand mechanical systems, components and processes to address technical and engineering challenges.

PSO2: To empower the student to build up career in industry or pursue higher studies in mechanical/interdisciplinary program.

PSO 3: To enhance the skills of the students with the ability to implement the scientific concepts for betterment of the society considering ethical, environmental and social values.

Scheme for B.Tech. (Mechanical Engineering)

FIRST SEMESTER

CODE	Subject	L	T	P	CREDIT
HUM-101-E	Essentials of Communication	3	1	-	3.5
MATH-101-E	Mathematics -I	3	2	-	4.0
PHY-101-E	Physics-I	3	1	-	3.5
CH-101-E	Chemistry	3	1	-	3.5
EE-101-E	Electrical Technology	3	1	-	3.5
ME-105-E	Engineering Graphics & Drawing	1	-	4	3.0
CH-103-E	Chemistry Lab	-	-	2	1.0
EE-103-E	Electrical Technology Lab	-	-	2	1.0
PHY-103-E	Physics Lab - I	-	-	2	1.0
				TOTAL	**24.0**

SECOND SEMESTER

CODE	Subject	L	T	P	CREDIT
HUM-102-E	Communication Skills in English	3	1	-	3.5
MATH-102-E	Mathematics -II	3	2	-	4.0
PHY-102-E	Physics-II	3	1	-	3.5
CSE-101-E	Fundamentals of computers & programming C	3	1	-	3.5
ME-103-E	Manufacturing processes	4	-	-	4.0
ME-101-E	Elements of Mechanical Engineering	3	1	-	3.5
ME-109-E	Elements of Mechanical Engineering Lab	-	-	2	1.0
PHY-104-E	Physics Lab - II	-	-	2	1.0
CSE-103-E	Computer Lab	-	-	2	1.0
ME-107-E	Workshop practice	-	-	4	2.0
				TOTAL	**27.0**

Total Credits=51

HUM-101-E (ESSENTIALS OF COMMUNICATION)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Inculcate minimum level of language proficiency among the students of engineering and technology.
2. To improve comprehension and expression skills of the students required for day to day; and classroom, academic, professional and cultural situations.

Unit I **Introduction:** mechanism and machines, kinematic links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

Unit-I **Semantics:** Synonyms, Antonyms, Homophones, Homonyms, Form and function of words

Unit-II **Syntax:** Sentence structures, Verb patterns and their usage

Unit-III **Phonetics:** Basic Concepts – Vowels, Consonants, Phonemes, Syllables; Articulation of Speech Sounds – Place and Manner of Articulation; Transcription of words and simple sentences, using International Phonetic Alphabet.

Unit-IV **Comprehension:** Listening and Reading comprehension – Note taking, Reviewing, Summarising, Interpreting, Paraphrasing and Précis Writing.

Unit-V **Composition:** Descriptive, Explanatory, Analytical and Argumentative Writing - description of simple objects like instruments, appliances, places, persons, principles; description and explanation of processes and operations; analysis and arguments in the form of debate and group discussion.

Unit-VI **Text:** English for Students of Science by A.Roy and P.L. Sharma (Orient Longman)

Chapters for Study:

i) "The year 2050" by Theodore J. Gordon.
ii) "The Mushroom of Death" by A. Bandhopadhyay.
iii) "The Discovery" by Herman Ould.

The prescribed text will be used as a case study for various components of the syllabus.

Unit-VII (For Internal Evaluation Only):

Book Review – Herein the students will be required to read and submit a review of a book (Literary or non-literary) of their own choice. This will be followed by a presentation of the same in the class.

Course Outcomes:

1. At the end of the course, a student will be able to express himself and to participate in the classroom discussions and other such academic or academic support activities.
2. The student will also be able to comprehend whatever he/she receives from informal interactions with the family, teachers and friends; and from formal communications taking place in lectures, laboratories and the like.
3. In general, the students will develop the ability to communicate effectively using suitable styles and techniques.

Text Books:

1. English for Students of Science edited by A. Roy and P.L. Sharma, Orient Longman.
2. Spoken English for India by R.K. Bansal and J.B. Harrison, Orient Longman.
3. Intermediate Grammar, Usage and Composition by M.L. Tickoo and A.E. Subramanian, Orient Longman.

Suggested Reading:

1. English Grammar, Composition and Correspondence by M.A. Pink and S.E. Thomas, S. Chand and Sons Pvt. Ltd.,Delhi.
2. A Practical English Grammar by Thomson and Martinet, OUP, Delhi.
3. Guide to Patterns and Usage in English by A.S. Hornby, OUP, Delhi.
4. A Textbook of English Phonetics for Indian Students by T. Balasubramanian, MacMillan, Chennai.
5. Better English Pronunciation by J.D.O'Connor, Cambridge Univ. Press, London.
6. English Vocabulary in Use by McCarthy, Foundation Books (Cambridge University Press), Delhi.
7. Assessing Listening by Buck, Foundation Books (Cambridge University Press), Delhi.
8. Reading between the Lines by McRae, Foundation Books (Cambridge University Press), Delhi.

SCHEME OF EXAMINATION:

There will be seven questions in all covering all the units, except Unit VII which (besides other modes of internal evaluation) is for internal assessment only.
All questions will be compulsory and will have sufficient internal choice.

Unit-I: 15 Marks

The question will be set so as to evaluate the following: Usage of the words given, Changing the grammatical quality and function of the words, One word Substitutes, synonyms, antonyms, homophones, homonyms.

Unit-II: 20 Marks

There will be one question having different parts. The question should test students' knowledge of sentence structures and verb patterns. The question can be in the nature of 'Do as directed', 'Tracing and rectifying structural Errors', 'Elucidating patterns through sentences and vice-versa', 'Changing the word-order', 'Synthesizing the sentences' and 'Completing the sentences', etc.

Unit-III: 15 Marks

There will be two questions from this Unit. Question one will be in the nature of short notes testing the basic concepts and articulation of speech sounds. The second question would require transcription of individual words and simple sentences.

Unit-IV: 15 Marks

Comprehension and Interpretation of a passage given (Literary or non-literary, newspaper article, story, extract from a speech etc.), will be judged for its vocabulary, general understanding and interpretation of the content in the form of question answer exercise, culling out important points, suggesting a suitable topic/title, summarising and précis writing etc.

Unit-V: 15 Marks

The question will require the definition, description, analysis, explanation of various objects and processes. Bedsides, a topic of contemporary relevance may be given for writing a paragraph in any one of the writing forms prescribed in the unit.

Unit-VI: 20 Marks

There will be two questions from the text prescribed. The first question will evaluate the comprehension of the text through short answer questions or a long answer question.
The second question will judge the linguistic aspect of the text such as using a particular word in its various syntactic forms like noun, adjective, verb etc.; matching the lists of words and their explanation; providing opposite/similar meanings, adding suffixes and prefixes etc.

MATH-101-E (MATHEMATICS-I)

L	T	P	Credit
3	2	----	4.0

Course Objectives:

1. To familiarize students with differentiation, Partial differentiation, integrations and vector calculus.
2. To familiarize students with application of differentiation and integrations.

Part-A

Introduction: mechanism and machines, kinematic links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

Infinite series: Convergence and divergence, Comparison, D' Alembert's ratio, Integral, Raobes, Logarithmic and Cauchy root tests, Alternating series, Absolute and conditional convergence.

Applications of differentiation: Taylor's and Maclaurin's series, Asymptotes, Curvature Asymptotes.

Partial differentiation & its applications: Functions of two or more variables; partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions, Jacobians, Higher order partial derivatives.

Homogeneous functions, Euler's theorem, Taylor's series for functions of two variables (without proof), maxima-minima of function of two variables, Lagrange's method of undetermined multipliers, Differentiation under integral sign.

Part-B

Applications of Single & Multiple Integration: Applications of single integration to find volume of solids and surface area of solids of revolution. Double integral, change of order of integration, Double integral in polar coordinates, Applications of double integral to find area enclosed by plane curves and volume of solids of revolution.

Triple integral, volume of solids, change of variables, Beta and gamma functions and relationship between them.

Vector Calculus: Differentiation of vectors, scalar and vector point functions Gradient of a scalar field and directional derivative, divergence and curl of a vector field and their physical interpretations.

Integration of vectors, line integral, surface integral, volume integral, Green, Stoke's and Gauss theorems (without Proof) and their simple applications.

Course Outcomes:

Get acquainted with use of various mathematical tools in engineering and sciences.

Text Books:

1. Advanced Engineering Mathematics: F. Kreyszig.
2. Higher Engineering Mathematics: B.S. Grewal.

Reference Books:

1. Engineering Mathematics Part-I : S.S. Sastry.
2. Differential and Integral Calculus: Piskunov.
3. Advanced Engineering Mathematics: R.K. Jain and S.R.K.Iyengar
4. Advanced Engg. Mathematics: Michael D. Greenberg

Note: ***Examiner will set eight questions, taking four from Part-A and four from Part-B. Students will be required to attempt five questions taking at least two from each part.***

PHY-101-E (PHYSICS-I)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

Course introduces the students to the following topics:

1. Optics and its behaviour viz; diffraction, polarization, LASER etc.
2. Waves and Oscillations, the famous Maxwell's equation will be covered along with fibre optics.
3. Special theory of relativity, Doppler shift, variation of mass with velocity.
4. Concepts of Nuclear Physics, Nuclear reactors, GM Counter, solid state detectors, etc. will be taught.

PART-A

PHYSICAL OPTICS

Interference: Division of wave front-Fresnel's biprism, Division of amplitude – Newton's rings, Michelson interferometer, applications.

Diffraction : Difference between Fraunhofer and Fresnel diffraction. Fraunhofer diffraction through a slit. Plane transmission diffraction grating, its dispersive and resolving powers.

Polarization: Polarised and unpolarized light, double refraction; Nicol prism, quarter and half wave plates, Polarimetry; Biquartz and Laurent's half-shade polarimeters, Simple concepts of photoelasticity.

LASER: Spontaneous and stimulated emissions, Laser action, characteristics of laser beam-concepts of coherence, He-Ne and semiconductor lasers (simple ideas), applications.

Fibre Optics: Propagation of light in fibres, numerical aperture, single mode and multi mode fibres, applications.

PART-B

Wave and Oscillations: Simple concepts of Harmonic Oscillator, resonance, quality factor.

E.M. wave theory-review of basic ideas, Maxwell's equations, simple plane wave equations, simple concepts of wave guides and co-axial cables, Poynting vector.

Dielectrics: Molecular theory, polarization, displacement, susceptibility, dielectric coefficient, permittivity & various relations between these, Gauss's law in the presence of a dielectric, Energy stored in an electric field.

Behaviour of dielectrics in a.c. field-simple concepts, dielectric losses.

Special Theory of Relativity: Michelson-Moreley experiment, Lorentz transformations, variation of mass with velocity, mass energy equivalence.

Nuclear Physics: Neutron Cross-section, Nuclear fission, Moderators, Nuclear reactors, Reactor criticality, Nuclear fusion. Interaction of radiation with matter-basic concepts, radiation detectors-ionisation chamber, G.M. Counter, Scintillation and solid state detectors, cloud chamber and bubble chamber.

Course Outcomes:

1. Create awareness about the vital role played by science and engineering in the development of new technologies with the blend of understanding old technology and approach to latest techniques,
2. Provide the necessary exposure to the practical aspects, which is an essential component for learning science. The acquaintance of basic physics principles would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches.

Text Books:

1. Physics of the Atom - Wehr, Richards & Adair (Narosa)
2. Perspectives of Modern Physics - Arthur Beiser (TMH)
3. Modern Engineering Physics – A.S. Vasudeva (S. Chand)

Reference Books:

1. Electricity and Magnetism – F.W. Sears (Narosa)
2. Physics Vol-I & II – Resnick & Halliday (Wiley Eastern)
3. A Text Book of Optics – Brij Lal & Subramanyam

Note: ***The Examiners will set eight questions, taking four from each part. The students will be required to attempt five questions in all selecting at least two from each part. All questions will carry equal marks.***

CH-101-E (CHEMISTRY)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To make the students familiarize about the basics of Chemistry.
2. Topics include the chemical aspects of engineering.

Unit-1: **Thermodynamics:** Second law, concept of Entropy, Entropy change for an ideal gas, free energy and work functions, Free energy change, Chemical Potential, Gibb's Helmholtz equation, Clausius - Clapeyron equation, Related numerical problems with above topics.

Unit-2: **Phase-Rule:** Terminology, Derivation of Gibb's Phase Rule Equation, One Component System (H2O System), Two Components systems, Eutectic system (Pb-Ag), system with congruent m.pt. (Zn-Mg), systems with incongruent m.pt. (Na-K), Applications of above Systems.

Unit-3: **Water & its treatment: Part I –** Sources of water, impurities in water, hardness of water and its determination, units of hardness, alkalinity of water and its determination, Related numerical problems, scale and sludge formation (composition properties and methods of prevention).

Unit-4: **Water and its treatment: Part II –** Treatment of water for domestic use, coagulation, sedimentation, filtration and dis-infection, water softening, Ion-exchange process, mixed bed demineralisation, Desalination (reverse osmosis) (electrodialysis).

Unit-5: **Corrosion and its prevention:** Galvanic & concentration cell, Dry and wet corrosion, Electrochemical theory of corrosion, Galvanic corrosion, pitting corrosion, water-line corrosion, differential aeration corrosion, stress corrosion, factors affecting corrosion, Preventive measures (proper design, Cathodic protection, protective coatings).

Unit-6: **Lubrication and Lubricants:** Friction, mechanism of lubrication, classification and properties of lubricants, Additives for lubricants, synthetic lubricants, Greases – Preparation & properties (consistency, drop point) and uses.

Unit-7: **Polymers and Polymerization:** Organic polymers, polymerisation, various types of polymerisation, effect of structure on properties of polymers, preparation properties and technical applications of thermo-plastics (PVC,PVA), thermosets (PF,UF), and elastomers (SBR,GR-N), Silicones, Introduction to polymeric compsites.

Unit-8: **Analytical Methods:** Thermal methods, Principle, method and application of Thermogravimetric analysis, Differential thermal analysis and Differential scanning calorimetry , (Experimental details are excluded),Spectroscopic methods, Spectrophotometry, interaction of E.M. radiations with a molecule and origin of spectrum, spectroscopic, techniques-vibrational and electronic spectroscopy

(Experimental details are excluded), conductometric titration, elementary discussion on Flame-photometry.

Course Outcomes:

1. Students are expected to critically assess and solve Industrial problems requiring the application of chemical principles.
2. Students are expected to be well versed with applied chemistry involved in engineering.

Text Books:

1. Engineering Chemistry, P.C. Jain, Monica Jain (Dhanpat Rai & Co.).
2. Chemistry in Engineering & Tech., Vol.I & II, Rajaram, Kuriacose (TMH).

Reference Books:

1. Instrumental methods of Chemical Analysis, MERITT & WILLARD (East-West Press).
2. Physical Chemistry, P.W. Atkin (ELBS, Oxford Press).
3. Physical Chemistry, W.J. Moore (Orient-Longman).

Note: ***Eight questions are to be set with a fair weightage of all the units. The candidates will be required to attempt five questions in all.***

EE-101-E (ELECTRICAL TECHNOLOGY)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Impart the fundamentals of electrical circuits.
2. Provide the comprehensive idea about working principles of electrical machines (Transformers, DC, Induction, and Synchronous machines), and measuring instruments.

Unit-1 **D.C. Circuits:** Ohm's Law, Kirchoff's Laws, D.C. Circuits, Nodal and Loop methods of Analysis.

Unit-2 **a) A.C. Circuits:** Sinusoidal signal, instantaneous and peak values, RMS and average values, phase angle, polar & rectangular, exponential and trigonometric representations; R,L and C components, behaviors of these components in A.C. circuits. Concept of complex power, power factor.

b) Transient Response: Transient response of RL, RC and RLC Circuits with step input.

Unit-3 **Network Theorems:** Thevenin's theorem, Norton's theorem, superposition theorem, maximum power transfer theorem, Reciprocity theorem, Tellegen's theorem, Milman's theorem. Star to Delta & Delta to Star transformation.

Unit-4 **Series and Parallel A.C. circuits:** Series and parallel A.C. circuits, series and parallel resonance, Q factor, cut-off frequencies and bandwidth.

Unit-5 **Three Phase Circuits:** Phase and line voltages and currents, balanced star and delta circuits, power equation, measurement of power by two wattmeter method, Importance of earthling.

Unit -6 **Transformers:** Principle, construction & working of transformer, Efficiency and regulation.

Unit- 7 **Electrical Machines:** Introduction to D.C. Machines, Induction motor, Synchronous machines.

Unit- 8 **Measuring Instruments:** Voltmeter, Ammeter, Watt meter, Energy meter.

Course Outcomes:

1. Gain the knowledge of basic concepts of DC/ 1-phase and 3-phase AC circuits.
2. Learn the principle and working of Transformer/ Electrical machine/measuring instruments.

Text Books:

1. Basic Electrical Engg (2nd Edition): Kothari & Nagarath, TMH
2. Electrical Technology (Vol-I): B.L Theraja & A K Theraja, S.Chand

Reference Books:

1. Electrical Engineering Fundamentals: Deltoro, PHI
2. Network Analysis: Valkenburg, PHI

NOTE: Eight questions are to be set in all by the examiner taking at least one question from each unit. Students will be required to attempt five questions in all.

ME-105 E (ENGINEERING GRAPHICS AND DRAWING)

L	T	P	Credit
1	---	4	3.0

Course Objectives:

1. Enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
2. Introduce universally accepted conventions and symbols for their usage in technical drawings.
3. Impart knowledge about principles/methods related to projections of one, two and three dimensional objects.
4. Inculcate the ability to translate geometric and topological information of common engineering object (two/three dimensional) into engineering drawing using standard graphical techniques.
5. Expose students to computer aided drafting tools.

Unit I **Various types of projections**: First and Third angle systems of orthographic projections. Projection of Points in different quadrants.

Unit II **Projections of Straight Lines:** Parallel to one or both reference planes, contained by one or both planes, perpendicular to one of the planes, inclined to one plane but parallel to the other planes, inclined to both the planes, true length of a line and its inclination with reference planes, traces of a line.

Unit III **Projections of Planes:** Parallel to one reference plane, inclined to one plane but perpendicular to the other, inclined to both reference planes.

Unit IV **Projections of Polyhedra Solids and Solids of Revolution:** In simple positions with axis perpendicular to a plane, with axis parallel to both planes, with axis parallel to one plane and inclined to the other, Projections of sections of Prisms, Pyramids, Cylinders and Cones. True shape of section. Development of surfaces of various solids.

Unit V **Isometric projections:** Introduction, isometric scale, Isometric views of plane figures, prisms, pyramids and cylinders.

Unit VI **Orthographic drawings** of Bolts and Nuts, Bolted Joints, Screw threads, Screwed Joints.

Unit VII **Free Hand Sketching:** Orthographic Views from Isometric, Views of Simple Machine Components such as Brackets, Bearing Blocks, Guiding Blocks and Simple Couplings.

Course Outcomes:

1. Understand and appreciate the importance of engineering graphics and drawing in engineering.

2. Understand the theory of projection.
3. Produce geometric construction, multi-view, sectional view, dimensioning and detail drawings of two and three dimensional objects.
4. Improve their visualization skills so that they can apply these skills in developing new products.

Text Book

1. Engineering Drawing Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal,Forty-Fourth Edition 2002, Charotar Publishing House.

Reference Books

1. Engineering Graphics and Drafting : P.S. Gill, Millennium Edition, S.K. Kataria and Sons.
2. A Text Book of Engineering Drawing : S.B. Mathur, Second Revised and Enlarged Edition 2000, Vikas Publishing House.
3. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, First Edition 2002, Vikas Publishing House.

Note: Some simple exercises may be attempted with AUTOCAD.

CH-103-E (CHEMISTRY LAB)

L	T	P	Credit
---	---	2	1.0

List of Experiments:

1. Determination of Ca++ and Mg++ hardness of water using EDTA solution.
2. Determination of alkalinity of water sample.
3. Determination of dissolved oxygen (DO) in the given water sample.
4. To find the melting & eutectic point for a two component system by using method of cooling curve.
5. Determination of viscosity of lubricant by Red Wood viscometer (No. 1 & No. 2).
6. To determine flash point & fire point of an oil by Pensky - Marten's flash point apparatus.
7. To prepare Phenol-formaldehyde and Urea formaldehyde resin.
8. To find out saponification No. of an oil.
9. Estimation of calcium in lime stone and dolomite.
10. Determination of concentration of $KMnO_4$ solution spectro-photometerically.
11. Determination of strength of HCl solution by titrating it against NaOH solution conductometerically.
12. To determine amount of sodium and potassium in a, given water sample by flame photometer.
13. Estimation of total iron in an iron alloy.

Suggested Books:

1. A Text Book on Experimental and Calculation – Engineering Chemistry, S.S. Dara, S. Chand & Company (Ltd.)
2. Essential of Experimental Engineering Chemistry, Shashi Chawla, Dhanpat Rai Publishing Company.
3. Theory & Practice Applied Chemistry – O.P. Virmani, A.K. Narula (New Age)

Note: At least ten experiments are to be performed by the students.

EE-103-E (ELECTRICAL TECHNOLOGY LAB)

L	T	P	Credit
---	---	2	1.0

List of Experiments:

1. To verify KCL and KVL.
2. To verify Thevenin's & Norton's Theorems.
3. To verify maximum power transfer theorem in D.C. Circuit & A.C circuit.
4. To verify reciprocity & Superposition theorems.
5. To study frequency response of a series R-L-C circuit and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit and determine resonant frequency & Q -Factor for various values of R, L, and C.
7. To perform direct load test of a transformer and plot efficiency Vs load characteristic.
8. To perform direct load test of a D.C. shunt generator and plot load voltage Vs load current curve.
9. To plot V-curve of a synchronous motor.
10. To perform O.C. and S.C. tests of a three phase induction motor.
11. To study various type of meters.
12. Measurement of power by 3 voltmeter / 3 ammeter method.
13. Measurement of power in a 3 phase system by two watt meter method.

NOTE:

1. ***At least 10 experiments are to be performed by students in the semester.***
2. ***At least 7 experiments should be performed from the above list; remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus of EE-101-E.***

PHY-103-E (PHYSICS LAB-I)

L	T	P	Credit
---	---	2	1.0

List of Experiments: The experiments in 1st semester will be based mainly upon optics, electrostatics, wave and oscillations which are the parts of the theory syllabus of 1st semester.

1. To find the wavelength of sodium light by Newton's rings experiment.
2. To find the wavelength of sodium light by Fresnel's biprism experiment.
3. To find the wavelength of various colours of white light with the help of a plane transmission diffraction grating.
4. To find the refractive index and cauchy's constants of a prism by using spectrometer.
5. To find the wavelength of sodium light by Michelson interferometer
6. To find the resolving power of a telescope.
7. To find the pitch of a screw using He-Ne laser.
8. To find the specific rotation of sugar solution by using a polarimeter.
9. To compare the capacitances of two capacitors by De'sauty bridge and hence to find the dielectric constant of a medium.
10. To find the flashing and quenching potentials of Argon and also to find the capacitance of unknown capacitor.
11. To study the photo conducting cell and hence to verify the inverse square law.
12. To find the temperature co-efficient of resistance by using platinum resistance thermometer and Callender and Griffith bridge.
13. To find the frequency of A.C. mains by using sonometer.
14. To find the velocity of ultrasonic waves in non-conducting medium by piezo-electric method.

Recommended Books:

1. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH).
2. Practical Physics – S.L.Gupta & V.Kumar (Pragati Prakashan).
3. Advanced Practical Physics Vol.I & II – Chauhan & Singh (Pragati Prakashan).

Note: Students will be required to perform atleast 10 experiments out of the list in a semester.

HUM-102-E (COMMUNICATION SKILLS IN ENGLISH)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Sharpen communication skills of the students with reference to organizational structure.
2. Expose them to the modern modes of communication.
3. Show the students importance of team work and give practice in group communication with reference to group dynamics.
4. Prepare the students for campus interviews.

Unit-I **Communicative Grammar**: Spotting the errors pertaining to nouns, pronouns, adjective and adverbs; Concord - grammatical concord, notional concord and the principle of proximity between subject and verb.

Unit-II **Lexis:** Idioms and phrases; Words often confused; One-Word Substitutes; Formation of words (suffixes, prefixes and derivatives); Foreign Words (A selected list)

Unit-III **Oral Communication: Part-A:** Introduction to principal components of spoken English – Word-stress patterns, Intonation, Weak forms in English

Part-B: Developing listening and speaking skills through various activities, such as (a) role play activities, (b) Practising short dialogues (c) Group discussion (d) Debates (e) Speeches (f) Listening to news bulletins (g) Viewing and reviewing T.V. programmes etc.

Unit-IV **Written Communication:** Developing reading and writing skills through such tasks/activities as developing outlines, key expressions, situations, slogan writing and theme building exercises. Reading verbal and non-verbal texts-like cartoons, Graphs and tabulated data etc.

Unit-V (For Internal Evaluation Only):

Book Review – Herein the students will be required to read and submit a review of a book (Literary or non-literary) of their own choice. This will be followed by a presentation of the same in the class.

Unit-VI Technical Writing:

a. Business Letters, Format of Business letters and Business letter writing
b. E-mail writing
c. Reports, Types of Reports and Format of Formal Reports
d. Press Report Writing

Course Outcomes:

1. Be able to express himself through the modern modes of communication and to participate in the group discussion and other such academic or academic support activities.
2. The student will also be able to perform well during GDs, presentations, and interviews.
3. The course, in particular, will enable the students to be effective language user with reference to communication in groups and group behaviour.

Suggested Reading:

1. Language in Use (Upper intermediate Level, Adrian Doff Christopher Jones, Cambridge University Press
2. Common Errors in English, Abul Hashem, Ramesh Publishing House, new Delhi.
3. Objective English, Tata Mc. Graw Hill Publishing Company Ltd., New Delhi.
4. Spoken English for India, R.K. Bansal & J.B. Harrison, Orient Longman, Delhi.
5. The sounds of English, Veena Kumar, Makaav Educational Software, New Delhi.
6. English Phonetics & Phonology, P. Roach, Cambridge University Press, London.
7. English for Engineers and Technologists: A Skill Approach, Vol. 2, Orient Longman,Delhi.
8. Business Communication, M.S. Ramesh and C.C. Pattanshetti, R.Chand and Company, Delhi
9. Group Discussion, Sudha Publications/Ramesh Publishing House, New Delhi.

SCHEME OF EXAMINATION:

All questions will be compulsory and will cover all the aspects of the syllabus **except unit V**. There will be sufficient internal choice.

Unit-I: 20 Marks

Questions No. 1 will require the students to carefully read the sentences given and trace the errors, if any, and then supply the correct alternatives/answers.

Unit-II: 20 Marks

Question No. 2 may have four or five parts testing knowledge of different items of vocabulary.

Unit-III: 20 Marks

Question No. 3 will have two parts of 10 marks each from part A and B of the unit. Part A will have content words, form words and sentences for stress marking, transcription and intonation marking respectively. Part B will test students' speaking skills through various oral tasks and activities - debate, group discussion and speech - in written form only.

Note: Speaking and listening skills will primarily be tested orally through internal assessment.

Unit-IV: 20 Marks

Question No. 4 may have many parts. The questions will be framed to test students' composition skills on the elements prescribed in the unit. For example, the students may be required to develop a hypothetical situation in a dialogue form, or to develop an outline, key expression, graph etc.

Unit-V is for internal assessment only.

Unit-VI: 20 Marks

Question No. 5 may have two parts. While the one part may require the students to frame either a press/news report for the print media or write the given business letter, or e-mail a message, the second part will have a theory question on the format of formal report and business letter.

MATH-102-E (MATHEMATICS-II)

L	T	P	Credit
3	2	----	4.0

Course Objectives:

1. To familiarize students with infinite series, matrices, Laplace transformation, ordinary and partial differential equations.
2. To familiarize students with applications of matrices, Laplace transformation, ordinary and partial differential equations.

Part-A

Matrices & its Applications: Rank of a matrix, elementary transformations, elementary matrices, inverse using elementary transformations, normal form of a matrix, linear dependence and in dependence of vactors, consistency of linear system of equations, linear and orthogonal transformations, eigen values and eigen vectors, properties of eigen values, Cayley - Hamilton theorem and its applications.

Part-B

Ordinary Differential Equations & its Applications: Exact differential equations. Equations reducible to exact differential equations. Applications of Differential equations of first order & first degree to simple electric circuits, Newton's law of cooling, heat flow and orthogonal trajectories.

Linear differential equations of second and higher order: Complete solution, complementary function and particular integral, method of variation of parameters to find particular Integral, Cauchy's and Legender's linear equations, simultaneous linear equations with constant co-efficients. Applications of linear differential equations to simple pendulum, oscillatory electric circuits.

Part-C

Laplace Transforms and its Applications: Laplace transforms of elementary functions, properties of Laplace transforms, existence conditions, transforms of derivaties, transforms of integrals, multiplication by t^n, division by t. Evaluation of integrals by Laplace transforms. Laplace transform of Unit step function, unit impulse function and periodic function. Inverse transforms, convolution theorem, application to linear differential equations and simultaneous linear differential equations with constant coefficients.

Partial Differential Equations and Its Applications: Formation of partial differential equations, Lagrange's linear partial differential equation, First order non-linear partial differential equation, Charpit's method. Method of separation of variables and its applications to wave equation and one dimensional heat equation, two dimensional heat flow, steady state solutions only.

Course Outcomes: Get acquainted with use of various mathematical tools in engineering and sciences.

Text and Reference Books:

1. Advanced Engg. Mathematics F Kreyszig
2. Higher Engg. Mathematics B.S. Grewal
3. Differential Equations – H.T.H. Piaggio.
4. Elements of Partial Differential Equations – I.N. Sneddon.

5. Advanced Engineering Mathematics – R.K. Jain, S.R.K.Iyengar.
6. Advanced Engg. Mathematics – Michael D. Greenberg.

Note: Examiner will set eight questions, taking two from Part-A, three from Part-B and three from Part-C. Students will be required to attempt five question taking at least one from each part.

PHY-102-E (PHYSICS-II)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

Course introduces the student to the following topics.

1. Elements of Crystallography, Dielectrics and their behaviour in circuit.
2. In Quantum Mechanics students will learn de-broglie hypothesis, Heisenberg uncertainty principle.
3. Free electron theory will make them understand the properties of Solid, Superconductivity, and band theory.
4. To have the glimpses of latest technology; Nanoscience and its approach towards material has been incorporated.

PART-A

CRYSTAL STRUCTURE

Space Lattice, unit cell and translation vectors, Miller indices, simple crystal structure, Bonding in solids, Experimental x-ray diffraction method, Laue method, powder Method, Point defects in solids, Elementary idea of quarks and gluons.

QUANTUM PHYSICS

Difficulties with Classical physics, Introduction to quantum mechanics-simple concepts, discovery of Planck's constant, Group velocity and phase velocity, Schrodinger wave equations - time dependant and time independent Schrodinger equations, Elementary ideas of quantum statistics.

FREE ELECTION THEORY

Elements of classical free electron theory and its limitations, Drude's Theory of Conduction, quantum theory of free electrons, Fermi level, Density of states, Fermi-Dirac distribution function, Thermionic emission, Richardson's equation.

PART-B

BAND THEORY OF SOLIDS

Origin of energy bands, Kronig, Penney Model (qualitative), E-K diagrams, Brillouin Zones, Concept of effective mass and holes, Classification of solids into metals, Semiconductors and insulators, Fermi energy and its variation with temperature. Hall effect and its Applications.

PHOTOCONDUCTIVITY AND PHOTOVOLTAICS

Photoconductivity in insulating crystals, variation with illumination, effect of traps, applications of photoconductivity, photovoltaic cells and their characteristics.

MAGNETIC PROPERTIES OF SOLIDS

Atomic magnetic moments, orbital diamagnetism, Classical theory of paramagnetism, ferro magnetism - molecular fields and domains.

SUPER CONDUCTIVITY

Introduction (experimental survey), Meissner effect, London equation.

Course Outcomes:

1. The course would provide the necessary exposure to the practical aspects, which is an essential component for learning science.
2. The acquaintance of basic physics principles would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches.

Text Books:

1. Introduction to Solid State Physics (VII Ed.) – Charles Kittel (John Wiley).
2. Quantum Mechanics – Powell and Crasemann (Oxford & IBH)
3. Fundamentals of Solid State Physics – B.S.Saxena, R.C.Gupta and P.N.Saxena (Pragati Prakashan).

Reference Books:

1. Solid State Physics – Pillai (New Age).
2. A text book of Engg. Physics – Avadhanulu and Kshirsagar (S.Chand)
3. Quantum Mechanics – Ghatak & Loknathan.

Note: ***The Examiners will set eight questions, taking four from each part. The students will be required to attempt five questions in all selecting at least two from each part. All questions will carry equal marks.***

CSE -101 E (Fundamentals of Computers & Programming in C)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Introduce students to basic terminology of computer.
2. Make them understand different problem solving techniques.
3. To make students learn art of C programming.
4. Make students capable of using pointers, files etc. for solving problems.

Unit I **Introduction:** mechanism and machines, kinematic links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

Unit-1: **An Overview of Computer System:** Anatomy of a digital Computer, Memory Units, Main and Auxiliary Storage Devices, Input Devices, Output Devices, Classification of Computers.

Radix number system: Decimal, Binary, Octal, Hexadecimal numbers and their inter-conversions; Representation of information inside the computers.

Unit-2: **Operating System Basics**: The user Interface, Running Programmes, Managing files, Introduction to PC operating Systems: Unix/Linux , DOS, Windows 2000.

Unit-3: **Internet basics::** Introduction to the basic concepts of Networks and Data Communications**,** How Internet works, Major features of internet, Emails, FTP, Using the internet.

Unit-4: **Programming Languages:** Machine-, Assembly-, High Level- Language, Assembler, Compiler, Interpreter, debuggers, Programming fundamentals: problem definition, algorithms, flow charts and their symbols, introduction to compiler, interpreter, assembler, linker and loader and their inter relationship

Unit-5: **C Programming language**: C fundamentals, formatted input/ output, expressions, selection statements, loops and their applications; Basic types, arrays, functions, including recursive functions, program organization: local and external variables and scope; pointers & arrays.

Unit-6: **Strings:** Strings literals, string variables, I/O of strings, arrays of strings; applications. Preprocessor: preprocessor directives, macro definition, conditional compilation; Structures, Unions and Enumerations: Structure variables and operations on structures; Structured types, nested array structures; unions; enumeration as integers, tags and types.

Declaration: Declaration syntax, storage classes, types qualifiers, declarators, initializers.

Program Design: modules, information hiding, abstract data types, difference between C & C++, Low level programming: Bitwise operators, Bit fields in structures, other low level techniques.

Unit-7: **Standard library:** Input / output; streams, file operations, formatted I/O, character I/O, line I/O, block, string I/O, Library support for numbers and character data, error handling:

Course Outcomes:

1. Understand the terminology related to computers.
2. To understand the concepts of Algorithms and flowcharts for their possible use in problem solving.
3. Write, compile and debug programs in C language.
4. Understand the concepts of memory by the use of pointers and to handle different type of files.
5. Analyse problems and write programs for solving them with the help of case studies.

Text Books:

1. Using Information Technology, 5th Edi, Brian K Williams & Stacey C. Sawyer, 2003, TMH
2. The C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 1988, PHI.
3. C Programming – A modern approach by K.N. King, 1996, WW Norton & Co.

Reference Books:

1. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998, TMH
2. Theory and problem of programming with C, Byron C Gottfried, TMH
3. Teach yourself all about computers by Barry Press and Marcia Press, 2000, IDG Books India.
4. Using Computers and Information by Jack B. Rochester, 1996, Que Education & Training.

Note: ***8 questions will be set by the examiner (at least 2 questions from unit-1 to 4, 2 each from unit –5&6, and one from unit-7). The students will be required to attempt 5 questions in all.***

ME- 103 E MANUFACTURING PROCESSES

L	T	P	Credit
4	----	----	4.0

Course Objectives:

1. Expose the students to the basic overview of manufacturing processes and idea about engineering materials with their properties and applications.
2. Provide to the students an understanding of plant layout, industrial safety methods, different types of accidents that may occur in industry, their causes and sources.
3. Impart knowledge of basic metal casting processes and checking of casting for quality.
4. Study metal forming techniques, extrusion, rolling, drawing and sheet metal forming and shearing operations.
5. Expose the students to the principles of the metal joining methods and getting familiar with different welding techniques (fusion and non-fusion), resistance and others.

Unit I **Introduction:** Introduction to Manufacturing Processes and their Classification. Industrial Safety; Introduction, Types of Accidents, Causes and Common Sources of Accidents, Methods of Safety, First Aid.

Unit II **Engineering Materials:** General Properties and Applications of Engineering Materials, Mild Steel, Medium Carbon Steel, High Carbon Steel, High Speed Steel and Cast Iron.

Unit III **Foundry:** Introduction to Casting Processes, Basic Steps in Casting Process, Pattern, Types of Patterns, Pattern Allowances, Risers, Runners, Gates, Moulding Sand and its composition, Sand Preparation, Molding Methods, Core Sands and Core Making, Core Assembly, Mold Assembly, Melting (Cupola) and Pouring, Fettling, Casting Defects and Remedies.

Unit IV **Cold Working (Sheet Metal Work):** Sheet Metal Operations, Measuring, Layout Marking, Shearing, Punching, Blanking, Piercing, Forming, Bending and Joining Advantages and Limitations.

Hot Working Processes: Introduction to Hot Working, Principles of Hot Working Processes, Forging, Rolling, Extrusion, Wire Drawing..

Unit V **Introduction to Machine Tools:** Specifications and Uses of commonly used Machine Tools in a Workshop such as Lathe, Shaper, Planer, Milling, Drilling, Slotter, Introduction to Metal Cutting. Nomenclature of a Single Points Cutting Tool and Tool Wear. Mechanics of Chips Formations, Type of Chips , Use of Coolants in machining.

Unit VI **Welding:** Introduction to Welding, Classification of Welding Processes, Gas Welding: Oxy-Acetylene Welding, Resistance Welding; Spot and Seam Welding, Arc Welding: Metal Arc, TIG & MIG Welding, Welding Defects and Remedies, Soldering & Brazing.

Unit VII **Plant Layout:** Objectives of Layout, Types of Plant Layout and their Advantages.

Course Outcomes:

1. Identify basic manufacturing processes and to ascertain the types of products that are cost effectively produced with each process.
2. Understand different plant layout, industrial safety methods, different types of accidents that occur in industry with their sources and causes.
3. Understand the manufacturing of product by casting processes as well as checking the casted product for its quality.
4. Understand different metal forming techniques, extrusion, rolling, drawing and sheet metal forming and shearing operations.
5. Understand the working and applications of machine tools such as lathe, shaper, planer, milling, drilling and slotter used in a workshop.

Text Books:

1. Workshop Technology Volt.I & II - Hazra & Chaudhary, Asian Book Comp., New Delhi.
2. Process and Materials of Manufacture -- Lindberg, R.A. Prentice Hall of India,New Delhi.
3. Principles of Manufacturing Materials and Processes - Campbell, J.S. - McGraw- Hill.

Reference Books:

1. Manufacturing Science - Amitabha Ghosh & Ashok Kumar Malik, - East-West Press.
2. Manufacturing Process and Systems - Ostwald, Munoz, John Wiley.
3. Workshop Technology, Vol. 1, 2 & 3 – Chapman, WAJ, Edward Arnold.

Note: Eight questions will be set by the examiner, taking at least one question from each unit. Students will be required to attempt five questions.

ME- 101 E ELEMENTS OF MECHANICAL ENGINEERING

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To understand the properties of steam boilers, turbines, and condensers.
2. To recognize the parts and operations of I.C Engines and gas turbines.
3. To understand the working of Water Turbines, pumps and hydraulic devices.
4. To understand the working of simple lifting machines and power transmission methods.
5. To understand the concepts of stress, strain, shear force diagrams and bending moment diagrams.

Unit I **Introduction:** mechanism and machines, kinematic links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

Unit I **Properties of Steam & Boilers:** Formation of steam at constant pressure, Thermodynamics properties of steam, Condition of steam, Steam tables, Measurement of dryness fraction by throttling calorimeter, Classification of boilers, Comparison of water and fire tube boilers mounting and accessories with their functions, Constructional and operational details of Cochran and Babcock and Wilcox boilers, Problems.

Unit II **Steam Turbines and Condensers:** Classification of turbines, Working principle of impulse and reaction turbine, Compounding of impulse turbine, Comparison of impulse and reaction turbines, Types of condensers, Cooling ponds and cooling towers, Condenser and vacuum efficiencies.

Unit III **I.C. Engines and Gas Turbines:** Introduction, Classification, Constructional details and working of two-stroke and four-stroke diesel and petrol engines, Otto, Diesel and Dual cycles, Working principle of gas turbine, Constant pressure gas turbine cycle.

Unit IV **Water Turbines, Pumps and Hydraulic Devices:** Introduction, Classification, Construction details and working of Pelton, Francis and Kaplan turbines, Specific speed and selection of turbines, Classification of water pumps and their working, Hydraulic jack and lift.

Unit V **Simple Lifting Machines:** Definition of machine, Velocity ratio, Mechanical advantage, Efficiency, Laws of machines, Reversibility of machine, Wheel and axle, Differential pulley block, Single, double and triple start worm and worm wheel, Single and double purchase winch crabs, Simple and compound screw jacks. Problems.

Unit VI **Power Transmission Methods and Devices:** Introduction to Power transmission, Belt drive, Rope drive, Chain drive, Pulley, Gear drive, Types of gears, Gear train, Clutches, Types and function of clutches, Types and function of brakes, Power measurement by dynamometer, Types of dynamometers.

Unit VII **Stresses and Strains:** Introduction, Concept & types of Stresses and strains, Poison's ratio, stresses and strains in simple and compound bars under axial loading, Stress-strain diagrams, Hooks law, Elastic constants & their relationships, Principle stresses & strains and principal- planes, Mohr's circle of stresses. Numerical problems.

Unit VIII **Bending Moment & Shear Force:** Definitions, SF and BM diagrams for cantilever and simply supported beam. Calculation of maximum SF, BM and point of contra-flexure under the loads of (i) concentrated load (ii) uniformly distributed load (iii) combination of concentrated and uniformly distributed loads. Problems.

Course Outcomes:

1. To understand the working of steam boilers, turbines, condensers, IC Engines and gas turbines.
2. To understand the working of Water Turbines, pumps, hydraulic devices, simple lifting machines and power transmission methods.
3. To calculate stress and strain, and to draw the shear force and bending moment diagrams.

Text Books:

1. Strength of Materials - G.H. Ryder, Pub.- ELBS.
2. Hydraulic and Fluid Mechanics – Modi and Seth, Pub. – Standard Book House, New Delhi
3. Engineering Thermodynamics – C.P. Arora, Pub. - TMH, New Delhi
4. Thermal Engineering – A.S. Sarad, Pub. - Satya Prakashan, New Delhi.
5. Engineering Mechanics – K.L. Kumar, Pub. - TMH, New Delhi.
6. Theory of Machines – S.S. Rattan, Pub. – TMH, New Delhi.

Reference Books:

1. Strength of Materials – Popov, Pub. - PHI, New Delhi.
2. Hydraulic Machines – Jagdish Lal, Pub.- Metropolitan, Allahbad.
3. Thermal Science and Engineering – D.S. Kumar, Pub. – Kateria & Sons, New Delhi.

NOTE: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attend only 5 questions.

ME- 109 E ELEMENTS OF MECHANICAL ENGINEERING LAB

L	T	P	Credit
----	----	2	1.0

Course Objectives:

1. To understand about steam boilers, turbines, and condensers.
2. To recognize the parts and operations of I.C Engines.
3. To understand the working of simple lifting machines and power transmission methods.
4. To understand the concepts of stress, strain, shear force diagrams and bending moment diagrams.

LIST OF EXPERIMENTS

1. To study Cochran & Babcock & Wilcox boilers.
2. To study the working & function of mountings & accessories in boilers.
3. To study 2-Stroke & 4-Stroke diesel engines.
4. To study 2-Stroke & 4-Stroke petrol engines.
5. To calculate the V.R., M.A. & efficiency of single, double & triple start worm & worm wheel.
6. To calculate the V.R., M.A. & efficiency of single & double purchase winch crabs.
7. To find the percentage error between observed and calculated values of stresses in the members of a Jib crane.
8. To draw the SF & BM diagrams of a simply supported beam with concentrated loads.
9. To study the simple & compound screw jacks and find their MA, VR & efficiency.
10. To study the various types of dynamometers.
11. To the constructional features & working of Pelton/Kaplan/Francis.
12. To prepare stress-strain diagram for mild steel & cast iron specimens under tension and compression respectively on a Universal testing machine.
13. To determine the Rockwell / Brinell /Vickers hardness no. of a given specimen on the respective machines.

Course Outcomes:

1. To understand the working of steam boilers, turbines, condensers, IC Engines and gas turbines.
2. To understand the working of Water Turbines, pumps, hydraulic devices, simple lifting machines and power transmission methods.
3. To calculate stress and strain, and to draw the shear force and bending moment diagrams.

Note:

1. ***Total ten experiments are to be performed in the Semester.***
2. ***At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed & set by the concerned Institution as per the scope of the syllabus.***

PHY-104-E (PHYSICS LAB-II)

L	T	P	Credit
----	----	2	1.0

List of Experiments:

The experiments in Second semester will be based upon electricity, Magnetism, Modern Physics and Solid State Physics which are the parts of theory syllabus.

1. To find the low resistance by carey - Foster's bridge.
2. To find the resistance of a galvanometer by Thomson's constant diffelction method using a post office box.
3. To find the value of high resistances by Substitution method.
4. To find the value of high resistances by Leakage method.
5. To study the characteristics of a solar cell and to find the fill factor.
6. To find the value of e/m for electrons by Helical method.
7. To find the ionisation potential of Argon/Mercury using a thyratron tube.
8. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
9. To study the characteristics of (Cu-Fe, Cu-Constantan) thermo couple.
10. To find the value of Planck's constant by using a photo electric cell.
11. To find the value of co-efficient of self-inductance by using a Rayleigh bridge.
12. To find the value of Hall Co-efficient of semi-conductor.
13. To study the V-I characteristics of a p-n diode.
14. To find the band gap of intrinsic semi-conductor using four probe method.
15. To calculate the hysteresis loss by tracing a B-H curve.

Recommended Books:

1. Advanced Practical Physics – B.L. Worshnop and H.T. Flint (KPH)
2. Practical Physics – S.L.Gupta & V.Kumar (Pragati Prakashan).
3. Advanced Practical Physics Vol.I & II – Chauhan & Singh (Pragati Prakashan).

Note: Students will be required to perform at least 10 experiments out of the list in a semester.

CSE -103 E (Computer Programming Lab)

L	T	P	Credit
----	----	2	1.0

Course Objectives:

1. Give students hands on training of C language.
2. Learn programming terminology and the syntax of various functions of C.
3. Learn C to solve problems given.

Representative programming problems: -

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average mail height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program using arrays to find the largest and second largest no. out of given 50 nos.
6. Write a program to multiply two matrices
7. Write a program to read a string and write it in reverse order
8. Write a program to concatenate two strings
9. Write a program to sort numbers using the Quicksort Algorithm.
10. Represent a deck of playing cards using arrays.
11. Write a program to check that the input string is a palindrome or not.

Course Outcomes:

1. Write, compile and debug programs in C language
2. Use various data types, pointers and file handling functions
3. To formulate problems and implement algorithms in C

Note: At least 5 to 10 more exercises to be given by the teacher concerned.

ME- 107 E (WORKSHOP PRACTICE)

L	T	P	Credit
----	----	4	2.0

Course Objectives:

1. Expose the students to various measuring instruments and tools used in various workshops, working of machine tools like Lathe, Milling, Drilling, and Shaper etc.
2. Practice of the students in for different shops such as welding, foundry, sheet metal, machine, carpentry etc.
3. Impart the knowledge on types of wood used for joints and patterns, mould making, casting etc.

List of Experiments / Jobs

1. To study different types of measuring tools used in metrology and determine least counts of vernier calipers, micrometers and vernier height gauges.
2. To study different types of machine tools (lathe, shape or planer or slotter, milling, drilling machines)
3. To prepare a job on a lathe involving facing, outside turning, taper turning, step turning, radius making and parting-off.
4. To study different types of fitting tools and marking tools used in fitting practice.
5. To prepare lay out on a metal sheet by making and prepare rectangular tray, pipe shaped components e.g. funnel.
6. To prepare joints for welding suitable fo r butt welding and lap welding.
7. To perform pipe welding.
8. To study various types of carpentry tools and prepare simple types of at least two wooden joints.
9. To prepare simple engineering components/ shapes by forging.
10. To prepare mold and core assembly, to put metal in the mold and fettle the casting.
11. To prepare horizontal surface/ vertical surface/ curved surface/ slots or V-grooves on a shaper/ planner.
12. To prepare a job involving side and face milling on a milling machine.

Course Outcomes:

1. Understand the basic operations and working of various machine tools, mould making and casting process, various types of welding processes, types of woods and their properties/ use, wooden joints, use of precise measuring instruments.

NOTE:

1. ***At least ten experiments/ jobs are to be performed/ prepared by students in the Semester.***
2. ***At least 8 experiments/ jobs should be performed / prepared from the above list, remaining two may either be performed/ prepared from the above list or designed & set by the concerned institution as per the scope of the syllabus of Manufacturing Processes and facilities available in the Institute.***

Scheme & Syllabi

for

B.Tech. 2nd year

Department of Mechanical Engineering
Guru Jambheshwar University of Science & Technology,
Hisar

THIRD SEMESTER

CODE	**Subject**	**L**	**T**	**P**	CREDIT
MATH-201-E	Mathematics -III	3	2	-	4.0
HUM-201-E	Economics	3	1	-	3.5
ME-201-E	Thermodynamics	3	1	-	3.5
ME-203-E	Strength of Material - I	3	1	-	3.5
ME-205-E	Engineering Mechanics	3	1	-	3.5
ME-207-E	Machine Drawing	1	-	4	3.0
EE-213-E	Electronics Engineering	3	1	-	3.5
ME-209-E	Strength of Material Lab - I	-	-	2	1.0
EE-219-E	Electronics Engineering Lab	-	-	2	1.0
ME-211-E	Computer Aided Drafting Lab	-	-	2	1.0
ME-213-E	Manufacturing Practice	-	-	3	1.5
				Total	**29.0**

FOURTH SEMESTER

CODE	**Subject**	**L**	**T**	**P**	CREDIT
HUM-202-E	Fundamentals of Management	3	1	-	3.5
ME-202-E	Manufacturing Technology	3	1	-	3.5
ME-204-E	Material Science	3	1	-	3.5
ME-206-E	Strength of Materials II	3	1	-	3.5
ME-208-E	Fluid Mechanics	3	1	-	3.5
ME-210-E	Energy Conversion	3	1	-	3.5
ME-212-E	Material Science Lab	-	-	2	1.0
ME-214-E	Fluid Mechanics Lab	-	-	2	1.0
ME-216-E	Energy Conversion Lab	-	-	2	1.0
UCC 581	*Environmental Studies	4	-	-	-
				TOTAL	**24.0**

*** Environmental Studies will be of qualifying nature.**

Total Credits=53

MATH-201-E (MATHEMATICS-III)

L	T	P	Credit
3	2	----	4.0

Course Objectives:

3. To familiarize students with Fourier series, Fourier integrals and transforms, matrices, Power series, Probability distribution, Hypothesis testing and linear programming techniques and their applications.

Part-A

Fourier Series and Fourier Transforms : Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and consine series.

Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac-delta function.

Part-B

Functions of Complex Variable: Definition, Exponential function, Trignometric and Hyperbolic functions, Logrithmic functions. Limit and Continuity of a function, Differnetiability and Analyticity.

Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions, application toflow problems. Integration of complex functions. Cauchy-Integral theorem and fourmula.

Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes andsingularities ofcomplex functions, Residues. Evaluation of real integrals using residues (around unit and semi circle only).

Part-C

Probability Distributions and Hypothesis Testing: Conditional probability, Bayes theorem and its applications, expected value of a random variable. Properties and application of Binomial, Poisson and Normal distributions.

Testing of a hypothesis, tests of significance for large samples, Student's t-distribution (applications only), Chi-square test of goodness of fit.

Linear Programming: Linear programming problems formulation, solving linear programming problems using (i) Graphical method (ii) Simplex method (iii) Dual simplex method.

Course Outcomes:

1. Get acquainted with use of various mathematical tools in engineering and sciences.

TEXT BOOKS:

1. Advanced Engg. Mathematics: F Kreyszig.
2. Higher Engg. Mathematics: B.S. Grewal.

REFERENCE BOOKS:

1. Advance Engg. Mathematics: R.K. Jain, S.R.K.Iyenger.
2. Advanced Engg. Mathematics: Michael D. Greenberg.
3. Operation Research: H.A. Taha.
4. Probability and statistics for Engineers: Johnson. PHI.

Note: ***Examiner will set eight questions, taking two from Part-A, three from Part-B and three from Part-C. Students will be required to attempt five question taking atleast one from each part.***

HUM-201-E (ECONOMICS)

L	T	P	Credit
3	1	----	3.5

COURSE OBJECTIVES: The purpose of this course is to:

1. Acquaint the student in the basic economic concepts and their operational significance and
2. Stimulate him to think systematically and objectively about contemporary economic problems.

UNIT-I

Definition of Economics - various definitions, Nature of Economic problem, Production possibility curve Economic laws and their nature. Relation between Science, Engineering, Technology and Economics.

UNIT-II

Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility - its practical application and importance.

UNIT-III

Meaning of Demand, Individual and Market demand schedule, Law of demand, shape of demand curve, Elasticity of demand, measurement of elasticity of demand, factors effecting elasticity of demand, practical importance & applications of the concept of elasticity of demand.

UNIT-IV

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale.

Various concepts of cost - Fixed cost, variable cost, average cost, marginal cost, money cost, real cost opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run.

UNIT-V

Meaning of Market, Types of Market - Perfect Competition, Monopoly, Oligoply, Monoplistic Competition (Main features of these markets)

Supply and Law of Supply, Role of Demand & Supply in Price Determinition and effect of changes in demand and supply on prices.

UNIT-VI

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization - meaning, merits and demerits. Globalisation of Indian economy - merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement.

Course Outcomes:

1. Employ economic theory, broadly defined, to provide an original analysis of current or historical events, to analyze social problems, and evaluate alternative public policy choices.
2. Present the results of their research using appropriate economic theories, concepts, and terminology, and methods in a professional setting.

TEXT BOOKS:

1. Principles of Economics: P.N. Chopra (Kalyani Publishers).
2. Modern Economic Theory – K.K. Dewett (S.Chand)

REFERENCE BOOKS:

1. A Text Book of Economic Theory Stonier and Hague (Longman's Landon)
2. Micro Economic Theory – M.L. Jhingan (S.Chand)
3. Micro Economic Theory - H.L. Ahuja (S.Chand)
4. Modern Micro Economics: S.K. Mishra (Pragati Publications)
5. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (S.Chand & Co.)
6. Indian Economy: Rudar Dutt & K.P.M. Sundhram

NOTE: Eight questions are to be set atleast one question from each unit and the students will have to attempt five questions in all.

ME- 201 E (THERMODYNAMICS)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the basic concepts of engineering thermodynamics and the practical application of basic thermodynamic laws.
2. To provide an understanding 2nd laws of thermodynamics in different thermodynamic processes along with the concept of availability and irreversibility of a system during non- flow and steady flow state.
3. To impart depth knowledge about the behaviour of ideal and real gases and the properties of pure substance during different phase transformations.
4. To study mathematical equations used to understand the different thermodynamic relations.

Unit I **Basic Concepts:** Macroscopic and Microscopic Approaches, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility. Problems.

Unit II **First Law of Thermodynamics:** Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, PMMFK, Steady flow energy equation, 1st Law Applied to Non- flow process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process, Problems.

Unit III **Second Law of Thermodynamics**: Limitations of First Law, Thermal Reservoir, Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMMSK. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot Theorem and its Corollaries, Thermodynamic Temperature Scale. Entropy,Clausius Inequality, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. Problems.

Unit IV **Availability and Irreversibility**: High and Low Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Dead state of a system, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility, Second law efficiencies of processes & cycles. Problems.

Unit V **Pure Substance:** Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam. Problems.

Unit VI **Ideal and Real Gases:** Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avogadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states. Mixture of Gases, Mass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and Specific Heats, Entropy for a mixture of non-reactive gases. Problems.

Unit VII **Thermodynamic Relations:** Maxwell Relations, Clapeyron Equation, Relations for changes in Enthalpy and Internal Energy & Entropy, Specific Heat Capacity Relations, Joule Thomson coefficient & inversion curve.

Course Outcomes:

1. Identify basic thermodynamic approaches and practical application of basic thermodynamic laws.
2. Understand the 2nd laws of thermodynamics and its importances in different thermodynamic processes alongwith the concept of availability and irreversibility of a system during non- flow and steady flow state.
3. Understand the behaviour of ideal and real gases and the properties of pure substance during different phase transformations.
4. Understand the basic air standard cycles used in thermodynamics and mathematical equations used to understand the different thermodynamic relations.

Text Books:

1. Engineering Thermodynamics – Jones and Dugan, PHI, New Delhi.
2. Fundamentals of Engineering Thermodynamics – E. Radhakrishnan, PHI, New Delhi.

Reference Books:

1. Theory and Problems of Thermodynamics – Y. V.C. Rao, Wiley Eastern Ltd., New Delhi.
2. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
3. Engineering Thermodynamics – P K Nag, Tata McGraw Hill

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

ME- 203 E (STRENGTH OF MATERIALS –I)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To evaluate various kinds of stresses and strains (axial, bending, torsional and shearing) in various structural elements due to different type of external loads.
2. To determine stresses in complex stress system.
3. To draw Shear Force and Bending Moment Diagrams in various kinds of beams subjected to different kinds of loads.
4. To determine deflections in various kinds of beams.
5. To understand the concept of buckling of columns.

Unit I **Simple Stresses & Strains:** Concept & types of Stresses and strains, Poison's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical.

Unit II **Compound Stresses & Strains:** Concept of surface and volumetric strains, two dimensional stress system, conjugate shear stress at a point on a plane, principle stresses & strains and principal- planes, Mohr's circle of stresses, Numerical.

Unit II **Shear Force & Bending Moments:** Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contra-flexure under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Problems.

Unit IV **Torsion of Circular Members:** Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust, Numericals.

Unit V **Bending & Shear Stresses in Beams:** Bending stresses in beams with derivation & application to beams of circular, rectangular, I,T and channel sections, composite beams, shear stresses in beams with combined bending, torsion & axial loading of beams, Numericals.

Unit VI **Columns & Struts:** Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Euler's, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numerical.

Unit VII **Slope & Deflection:** Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported

beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical.

Unit VIII **Fixed Beams:** Deflections, reactions and fixing moments with SF & BM calculations & diagrams for fixed beams under (i) concentrated loads, (ii) uniformly distributed load and (iii) a combination of concentrated loads & uniformly distributed load.

Course Outcomes:

1. Understand the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.
2. Understand the concepts of principal stresses, maximum shearing stress in complex stress system.
3. Draw Shear Force Diagram, Bending Moment Diagrams and find deflections in various kinds of beams subjected to different kinds of loads.
4. Understand the concepts the stresses and strains in axially-loaded members, torsion members, and members subject to flexural loadings and columns.

Text Books:

1. Strength of Materials – G.H.Ryder - Macmillan, India
2. Strength of Materials– Andrew Pytel and Fredinand L.Singer, Addison – Wesley

Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials A Rudimentary Apprach – M.A. Jayaram, Sapna Book House, Bangalore

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

ME 205 E (ENGINEERING MECHANICS)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Comprehensive theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
2. In-depth understanding of specialist bodies of knowledge within the engineering discipline.
3. Application of establish engineering methods to complex engineering problem solving.
4. Application of systematic engineering synthesis and design process.

Unit-I **Review of Basic Force Systems:** Dimensions and units of mechanics, idealization of mechanics, laws of mechanics, vector algebra review, moment of a force about a point and axis, the couple and couple moment, addition and subtraction of couples, moment of a couple about a line, translation of a forceto a parallel position, resultant of a force system, Problems (vector method).

Unit-II **Equilibrium:** Introduction, free body diagram, control volumes, general equations of equilibrium, two point equivalent loading, static in-determinacy, simple truss, method of joints, method of sections, co-planer cable-loading a function of x, coplanar cables- loading the weight of the cable itself. Problems.

Unit-III **Properties of Surfaces & Moments and Products of inertia :** First moment of an area and the centroid, principal axes, formal definition of inertia quantities, relation between mass-inertia terms and area-inertia terms, translation of coordinate axes, transportation properties of the inertia terms, a brief introduction to tensors, the inertia of ellipsoid and principal moments of inertia, Problems (vector method).

Unit-IV **Kinematics of Particles and Rigid Bodies:** Velocity and acceleration in path and cylindrical coordinates, motion of a particle relative to a pair of translating axes, translation and rotation of rigid bodies, Chasles theorem, moving references, velocity and acceleration for different references, inertia and coriolis forces. Problems (vector method).

Unit-V **Particle Dynamics, Energy Methods & Momentum Methods:** Newton's law for rectangular coordinates & cylindrical coordinates, rectifier translation, central force motion, Newton's law for path variables, work energy equations, work energy equations for a systems of particles, linear and angular momentum equations for a systems of particles. Problems (vector method).

Unit-VI **Variational Mechanics:** Hamilton principle, Lagrange equations, principle of virtual work, methods of minimum potential energy, stability.

Course Outcomes:

1. Use scalar and vector analytical technique for analyzing forces in statically determinate structures.
2. Apply fundamental concept of kinematics and kinetics of particles to the analysis of simple practical problems.
3. Apply basic knowledge of mathematics and physics to solve real world problem.

Text Book:

1. Engineering Mechanics - Statics & Dynamics by I.H. Shames, PHI, New Delhi.
2. Engineering Mechanics – Timoschenko.

Reference Books:

3. Statics & Dynamics by J.L. Meriam, JohnWiley & Sons (P) Ltd. New York.
4. Statics & Dynamics by Beer & Johnson, MGH, New Delhi.

NOTE : In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

ME- 207 E (MACHINE DRAWING)

L	T	P	Credit
1	----	4	3.0

Course Objectives:

1. Understanding of how to do drawing of machine parts and detailed drawing of assembled parts drawing of various machines.
2. To create awareness and better communication of machine components and exposure to students about their various views how to drawn on drawing sheets.
3. Application of engineering design and detailed drawing and basic drawing.

PART-A

Introduction to BIS Specification SP: 46 – 1988 Code of Engineering drawing – Limits, fits and Tolerance (Dimensional and Geometrical tolerance), Surface finish representation.

Gear: Gear terminology, I.S. convention representation of assembly of spur gears, helical gears, bevel gears, worm and worm wheel.

PART-B

Orthographic views from isometric views of machine parts/components. Dimensioning, Sectioning. Exercises on Coupling, Crankshaft, Pulley, Piston and Connecting rod, Cotter and Knuckle joint. Riveted Joint and Welded Joint.

PART-C

Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing, Steam stop valve, Drill jigs and Milling fixture.

Course Outcomes:

1. Understanding to how to do drawing of machine parts and detailed drawing of assembled parts drawing of various machines.
2. To create awareness and batter communication of machine components and exposure to students about their various views how to drawn on drawing sheets.
3. Application of engineering design and detailed drawing and basic drawing.

Text Books:

1. Machine Drawing - N D Bhatt and V M Panchal, Charotar Publishing House.
2. A Text Book of Machine Drawing - P S Gill Pub.: S K Kataria & Sons.
3. Engineering Graphics with Auto CAD 2002 -JamesD.Bethune, Pearson Education.

Reference Books:

1. A Text Book of Machine Drawing Laxmi Narayana and Mathur, M/s. Jain Brothers, New Delhi.
2. Machine drawing by N Sidheshwar, Kaneohe, V S Sastry, TMH., New Delhi.

NOTE:

1. ***In the semester examination, the examiner will set total six questions in all, taking two questions from each part. The students will be required to attempt three questions in all, taking one question from each part.***
2. ***The questions from Part-A and Part-B will carry 20 marks each. Question from Part-C will carry 60 marks.***

EE-213-E (ELECTRONICS ENGINEERING)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To make the students familiar with the concept of semiconductor materials, devices and its properties.
2. To explain the construction, characteristics, and operation of PN diode, Transistors, power amplifiers and digital gates.
3. To familiarize with the application of different semiconductor devices.

Unit-I **Diodes:** P-N junction, P-N junction as a rectifier, V-I characteristics, Breakdown diodes, Light emitting diodes, Load – Line concept, Clipping, Clamping, Rectifiers.

Unit-II **Transistors:** Operation and Characteristics of a Transistor, Common Emitter, Common Collector and Common Base Configurations of a transistor, Biasing and Transistor as an amplifier and oscillator.

Unit-III **Op-Amps:** Basic Characteristics of an OP-AMP, Applications of OP-AMP (Inverter, Non-Inverter, Integrator, Differentiator, Logarithmic amplifier, Square wave generator).

Unit-IV **Power Amplifiers:** Class A, Class B and Class C Amplifiers.

Unit-V **Stabilised Power Supplies:** Regulated power supply, series voltage regulator.

Unit-VI: **Digital gates:** Binary numbers, OR, AND, NAND, NOR, NOT, EX-OR Gates.

Course Outcomes:

1. Understand the significance of semiconductor materials in electronics.
2. Develop the understanding of basic concepts of diodes and transistors.
3. Become capable of using diode, transistors and digital gates in their lab experiments.

Text Book:

1. Integrated Electronics Milman & Halkias (MGH).

Reference Books:

1. Digital Electronics by R.P.Jain (MGH).
2. Microelectronics – Ramana (MGH).
3. Electronics Principles Malvino, TMH.

Note:

1. Five out of eight questions are to be attempted.
2. At least one question should be set from each unit.

ME- 209 E (STRENGTH OF MATERIAL LAB – I)

L	T	P	Credit
----	----	2	1.0

Course Objectives:

1. To find out the strength of given specimen subjected to one type of load (tensile, compressive, shear, bending and torsion).
2. To find the hardness value (Rockwell, Vickers, Brinell) of given specimen.

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod & Charpy).
6. To study the Universal testing machine and perform the tensile test.
7. To perform compression & bending tests on UTM.
8. To perform the sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.
10. To determine Mechanical Advantage and Efficiency of Single and Double Purchase Winch Crab.
11. To determine Mechanical Advantage and Efficiency of Worm and Worm Gear of Single,
12. Double and Triple start.
13. To determine Mechanical Advantage, Efficiency of Simple and Compound Screw Jack.
14. To find Moment of Inertia of a Fly Wheel.
15. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under point
    and Distributed Loads.

Course Outcomes:

1. Predict the behavior of the solid bodies under various types of loading (tensile, compressive,
   shear, bending and torsion).
2. Interpret the experimental results for material selection in engineering applications.

Note:

1. At least ten experiments are to be performed in the semester.
2. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.

EE-219-E (ELECTRONICS ENGINEERING LAB)

L	T	P	Credit
----	----	2	1.0

Course Objectives:

1. To make the students familiar with the use and applications of different semiconductor devices.
2. To explain the characteristics, and operation of PN diode, Transistors, power amplifiers and digital gates.

List of Experiments:

1. Study of V-I Characteristics of Diode.
2. Study of a Clipping and clamping circuits.
3. Study of a half wave rectifier.
4. Study of a Full wave rectifier.
5. Study and Analysis of a Transistor in Common Emitter Configuration.
6. Study of OP-AMP as Inverter and Comparator.
7. Study of OP-AMP as Differentiator.
8. Study of OP-AMP as Integrator.
9. Study of OP-AMP as Square wave generator.
10. Realization of Truth Tables of AND, OR, NOT Gates.
11. Realization of Truth Tables of NAND, NOR and EX-OR Gates.

Course Outcomes:

1. Understand the significance of semiconductor materials in electronics.
2. Develop the understanding of characteristics and operation of diodes and transistors.
3. Become capable of using diode, transistors and digital gates in their lab experiments.

Note:

1. ***At least seven experiments should be performed from above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.***

ME – 211 E (COMPUTERS AIDED DRAFTING LAB)

L	T	P	Credit
----	----	2	1.0

Course Objectives:

1. Expose the students to basics features of design & drafting software packages (AutoCad-2002, I-DEAS, Pro-Engineer etc.)
2. Practice of the students for geometric drawing of different mechanical components using drafting software.

List of Experiments:

1. Study of V-I Characteristics of Diode.
2. Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in
   engineering drawing, saving the file with .dwg extension.
3. Layout drawing of a building using different layer and line colors indicating all Building details. Name the details using text commands, Make a title Block.
4. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.
5. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap.
6. Draw quarter sectional isometric view of a cotter joint.
7. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
8. Draw 3D models by extruding simple 2D objects, dimension and name the objects.
9. Draw a spiral by extruding a circle.

Course Outcomes:

1. Understand the basic features of design & drafting software packages.
2. Use the design package for designing & drafting of different mechanical component.

Note: The students will be required to carry out the following exercises using educational soft-wares

(AutoCad-2002, I-DEAS, Pro-Engineer etc).

ME- 213 E (MANUFACTURING PRACTICE)

L	T	P	Credit
----	----	3	1.5

Course Objectives:

1. To expose the students, the practical knowledge of casting, welding, machining, grinding, drilling processes
2. To provide a hand on practice to the students on lathe by cutting external threads on a job.
3. To provide a practical study for levelling of machine tool and testing its accuracy.
4. To impart knowledge to the students about the development and manufacturing of sheet-metal components.
5. To expose to the students knowledge of drawing for manufacturing of patterns used in casting.

List of Experiments:

1. To make a pattern for a given casting with all the necessary allowances, parting line, running system details. Prepare the mold and make the casting. Investigate the casting defects and suggest the remedial measures.
2. To make a component involving horizontal and vertical welding and study the welding defects and suggests their remedies.
3. To prepare a job on surface grinder/cylindrical grinder and measure the various parameters of the finished piece.
4. To cut external threads on a lathe.
5. Manufacture and assembly of a unit consisting of 2 to 3 components to have the concept of tolerances and fits (shaft and bush assembly or shaft, key and bush assembly or any suitable assembly).
6. Leveling of machine tools and testing their accuracy.
7. Disassembly and assembly of small assemblies such as tail stock, bench vice, screw jack etc.
8. Development and manufacture of complex sheet-metal components such as funnel etc.
9. Multi slot cutting on milling machine by indexing.
10. Drilling and boring of a bush.
11. Modeling of 3D runner system and creation of drawing for manufacturing of the casting patterns.
12. Development of blank size for complex sheet metal components using CAD/CAE software and compare results with manual calculation method.

Course Outcomes:

1. Identify basic knowledge of different processes like casting, welding, machining, grinding their defects and their remedies.
2. Understand the manufacturing and assembly of a unit with shaft, key and bush.
3. Understand the levelling of machine tools and testing their accuracy.
4. Understand the development and manufacturing of a sheet-metal component.
5. Understand the drawing and manufacturing of the modeling of 3D runner system

Note:

1. ***At least ten experiments are to be performed in the semester.***
2. ***At least eight experiments should be performed from the above list including exercises and 12. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.***

HUM-202-E (FUNDAMENTALS OF MANAGEMENT)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To acquire knowledge of key principles of management and be able to critically apply this knowledge to the analysis of a complex case study.

2. To understand and apply a selected management topic to a real organizational setting.

UNIT-I Meaning of management, Definitions of Management, Characteristics of management, Management Vs. Administration. Management-Art, Science and Profession. Importance of Management. Development of Management thoughts. Principles of Management. The Management Functions, Inter-relationship of Managerial functions.

UNIT-II Nature and Significance of staffing, Personnel management, Functions of personnel management, Manpower planning, Process of manpower planning, Recruitment, Selection; Promotion - Seniority Vs. Merit. Training - objectives and types of training.

UNIT-III Production Management : Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Brief introduction to the concepts of material management, inventory control; its importance and various methods.

UNIT-IV Marketing Management - Definition of marketing, Marketing concept, objectives & Functions of marketing. Marketing Research - Meaning; Definition; objectives; Importance; Limitations; Process. Advertising - meaning of advertising, objectives, functions, criticism.

UNIT-V Introduction of Financial Management, Objectives of Financial Management, Functions and Importance of Financial Management. Brief Introduction to the concept of capital structure and various sources of finance.

Course Outcomes:

1. To equip themselves with key knowledge, skill and competencies in various aspects of management.

2. To develop analytical and critical thinking skills in the context of contemporary organisations.

BOOKS RECOMMENDED :

TEXT BOOKS :

1. Principles and Practice of Management - R.S. Gupta, B.D.Sharma, N.S. Bhalla. (Kalyani Publishers)

2. Organisation and Management - R.D. Aggarwal (Tata Mc Graw Hill)

REFERENCE BOOKS :

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)

2. Management – Harold, Koontz and Cyrilo Donell (Mc.Graw Hill).

3. Marketing Management – S.A. Sherlikar (Himalaya Publishing House, Bombay).

4. Financial Management - I.M. Pandey (Vikas Publishing House, New Delhi)

5. Management - James A.F. Stoner & R.Edward Freeman, PHI.

NOTE: Eight questions are to be set atleast one question from each unit and the students will have to attempt five questions in all.

ME-202 E (MANUFACTURING TECHNOLOGY)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To provide knowledge of manufacturing processes like casting, forming, welding, extrusion & sheet metal operations etc.

Unit I **Metal Casting Processes:** Advantages and limitations, sand mold making procedure. Patterns and Cores: Pattern materials, pattern allowances, types of pattern, color coding. Molding materials: Molding sand composition, sand preparation, sand properties and testing, Sand molding processes

Unit II **Cores:** Types of cores, core prints, chaplets, and chills. Gating systems: Gates and gating systems risers**.** Melting practice: Cupola, charge calculations. Casting cleaning and casting defects, Fettling, defects in castings and their remedies, methods of testing of castings for their soundness.

Unit III **Special Casting Processes:** Shell molding, precision investment casting, permanent mold casting, die casting, centrifugal casting, continuous casting,

Unit IV **Metal Forming Processes:** Nature of plastic deformation, hot working and cold working, Principles of rolling, roll passes, roll pass sequences. Forging: Forging operations, smith forging, drop forging, press forging, forging defects.

Unit V **Extrusion and other processes:** Extrusion principle, hot extrusion, cold extrusion, wire drawing, swaging, tube making**.** Sheet metal operations: Press tools operations, hearing action, drawing dies, spinning, bending, stretch forming, embossing and coining.

Unit VI **Gas and Arc Welding:** Classification: oxy- acetylene welding equipment and techniques. Electric arc welding: Electrodes, manual metal arc welding, inert gas shielded arc welding, tungsten inert gas welding (TIG), metal inert gas welding (MIG), submerged arcwelding (SAW).

Unit VII **Resistance Welding:** Principles, resistance spot welding, resistance seam welding, upset welding, flash welding,

Unit VIII **Other Welding Processes:** Introduction thermic welding, electro slag welding, electron beam welding, forge welding, friction welding, diffusion welding, brazing and soldering.

Course Outcomes:

1. To learn about the different casting processes, defects in casting & their remedies.
2. Students can differentiate between hot working and cold working.
3. A student can choose suitable welding process according to material, requirements and service conditions.

Text Books:

1. Principles of Manufacturing Materials & Processes – Campbell J. S., Publisher – Mc Graw Hill.
2. Manufacturing Science - Ghosh A; Mallik A.K. Affiliated East-West Press Pvt. Ltd., New Delhi

Reference Books:

1. Foundry Technology - K.P. Sinha, D.B. Goel, Roorkee Publishing House.
2. Welding and Welding Technology, Richard L. Little Tata McGraw Hill Ltd.
3. Principle of Metal casting - Rosenthal, Tata McGraw Hill, New Delhi
4. Manufacturing Processes and Systems: Ostwald Phillip F., Munoz Jairo, John Wiley & Sons
5. Manufacturing Technology-Foundry, Forming and Welding - P.N. Rao, Tata McGraw Hill
6. Elements of Manufacturing Processes – B.S. Nagendra Parasher, RK Mittal, PHI N. Delhi

Note: ***In the semester examination, the examiner will set 8 questions, at least one question from each unit, and students will be required to attempt only 5 questions.***

ME- 204 E (MATERIAL SCIENCE)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

The objective of the course is to provide basic understanding of engineering materials, their structure and the influence of structure on mechanical, chemical, electrical and magnetic properties.

Unit I **Crystallography:** Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numericals related to crystallography.

Unit II **Imperfection in metal crystals:** Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

Unit III **Solid solutions and phase diagram:** Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

Unit IV **Heat Treatment:** Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening. Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

Unit V **Deformation of Metal:** Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking. Recovery, re-crystallization and grain growth.

Unit VI **Failures of metals:** Failure analysis, fracture, process of fracture, types of fracture, fatigue, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue.

Unit VII **Creep & Corrosion:** Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism and effect of corrosion, prevention of corrosion.

Unit VIII **Plastic, Composite and Ceramics:** Polymers, formation of polymers, polymer structure and crystallinity, polymers to plastics types, reinforced particles-strengthened and dispersion strengthened composites. Ceramic materials: Types of ceramics, properties of ceramic, ceramic forming techniques, mechanical behavior of ceramic.

Course Outcomes:

1. Understand structure-property correlation;
2. Read phase diagrams and can predict the properties of the solid based on the phase diagram.

3. Discriminate between materials based on their electrical and magnetic properties and should be able to describe temperature and field dependence of electrical and magnetic properties.
4. Select materials based on their properties for a defined application.

Text Books:

1. Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
2. Material Science - Narula, Narula and Gupta. New Age Publishers

Reference Books:

1. Material Science & Engineering –V. Raghvan, Prentice Hall of India Pvt. Ltd, New Delhi
2. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpat Rai & Sons
3. Material Science and Engineering-An Introduction - Callister; W.D., John Wiley & Sons., Delhi.
4. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, New Delhi

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME- 206 E (STRENGTH OF MATERIALS-II)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To understand the concepts of energy theorems.
2. To calculate the stresses and strains in pressure vessels, rotating bodies and springs.
3. To calculate the stresses and strains in beams subjected to unsymmetrical bending.
4. Design of machine elements using theories of deformable bodies.

.

Unit I **Strain Energy & Impact Loading:** Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's & Maxwell's theorems, Numericals.

Unit II **Theories of Elastic Failure:** Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

Unit III **Unsymmetrical Bending:** Properties of beam cross section, product of inertia, ellipse of inertia, slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals.

Unit IV **Thin Walled Vessels :** Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire would cylinders, Numericals.

Unit V **Thick Cylinders &Spheres:** Derivation of Lame'sequations, radial& hoop stresses and strains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft, Numericals.

Unit VI **Rotating Rims & Discs:** Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.

Unit VII **Bending of Curved Bars:** Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano's theorem stresses in simple chain link, deflection of simple chain links, Problems.

Unit VIII **Springs:** Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

Course Outcomes:

1. Understand the concepts of energy theorems.
2. Calculate the stresses and strains in pressure vessels, rotating bodies and springs.
3. Determine the stresses and strains in members subjected to combined loading and apply the theories of failure for static loading.

Text Books:

1. Strength of Materials – G.H. Ryder, Third Edition in SI Units 1969 Macmillan, India.
2. Mechanics of Materials – (Metric Edition) : Ferdinand P. Beer and E. Russel Johnston, Jr. Second Edition, McGraw Hill.

Reference Books:

1. Book of Solid Mechanics – Kazmi, Tata Mc Graw Hill
2. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd.
3. Advanced Mechanics of Solids and Structures – N. Krishan Raju and D.R.Gururaje-Narosa Publishing House.
4. Strength of Materials – Andrew Pytel and Fredinand L. Singer Fourth Edition, Int. Student Ed. Addison – Wesley Longman.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

ME- 208-E (FLUID MECHANICS)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. The aim of this course is to introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. To learn fluid properties and hydrostatic law – to understand the importance of flow measurement and its applications in Industries and to obtain the loss of flow in a flow system.
3. The development of boundary layers and advancement of practical hydraulics and understanding the concept of advanced fluid mechanics.

Unit I **Fluid Properties and Fluid Statics:** Concept of fluid and flow, ideal and real fluids, continuum concept, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, hydrostatic equation, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium. Problems.

Unit II **Fluid Kinematics:** Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net. Problems.

Unit III **Fluid Dynamics:** Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orifice meter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications. Problems.

Unit IV **Potential Flow:** Uniform and vortex flow, flow past a Rankin half body, source, sink, source-sink pair and doublet, flow past a cylinder with and without circulation. Problems.

Unit V **Viscous Flow:** Flow regimes and Reynold's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems.

Unit VI **Flow Through Pipes:** Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Problems.

Unit VII **Boundary Layer Flow:** Boundary layer concept, displacement, momentum and energy thickness, von-karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies, lift and drag on a cylinder and an airfoil, Problems.

Unit VIII **Turbulent Flow:** Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes. Problems.

Course Outcomes:

1. To find frictional losses in a pipe when there is a flow between two places.
2. To calculate the problems related to fluid.
3. To analyze the model and the prototype.
4. To find the dependent and independent parameters for a model of fluid flow.
5. Explain the various methods available for the boundary layer separation.

Text Books:

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill.
2. Mechanics of Fluids – I H Shames, Mc Graw Hill.

References Books:

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH.
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons.
3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

ME- 210 E (ENERGY CONVERSION)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Understand the combustion of fuels and formation of flue gases in the exhaust.
2. To recognize the parts and operations of high and low pressure steam boilers.
3. To understand the energy conversion in steam power plant through various vapor power cycles.
4. To analyze flow of steam through nozzles, turbines and condensers.

Unit I **Fuels and Combustion**: Classification of fuels- solid, liquid & gaseous fuels, Combustion equations, Stichiometric air-fuel ratio, Excess air, Exhaust gas analysis, Orsat apparatus. Enthalpy and internal energy of combustion, Enthalpy of formation, Adiabatic flame temperature, Gibb's and Helmholtz functions, Calorific values of fuel, Problems.

Unit II **Steam Boilers and Draft:** Classification, comparison between fire and water tube boilers, Essentials of a good boiler, Constructional and operational details of Locomotive& Lancashire Boilers, High pressure boilers- Benson, Lamont, Loeffler and Velox boilers, Boiler mountings and accessories, Boiler performance, Natural& Artificial drafts, Chimney height, Maximum draft and chimney efficiency, Boiler heat balance sheet, Problems.

Unit III **Vapour Power Cycles:** Carnot and Rankine vapour cycles, effect of operating conditions on thermal efficiency of Rankine cycle, Rankine cycle with superheat, reheat and regeneration, Binary vapour cycle, Problems..

Unit IV **Flow Through Nozzles:** Velocity and heat drop, mass discharge through a nozzle, critical pressure ratio and its significance, effect of friction and nozzle efficiency, supersaturated flow, design pressure ratio, Problems.

Unit V **Steam Turbines:** Classification, Impulse Turbine- Flow through blades, velocity diagram, power output and efficiency, maximum blade efficiency of single stage impulse turbine, blade friction, compounding of impulse turbine. Reaction Turbine-Flow through impulse reaction blades, degree of reaction, velocity diagram, power output, efficiency and blade height, comparison of impulse and impulse reaction turbines. Losses in steam turbines, stage efficiency, overall efficiency and reheat factor. Governing of steam turbines, Problems.

Unit VI **Steam Condensers:** Elements of a condensing plant, types of condensers, comparison of jet and surface condensers. Condenser vacuum, sources of air leakage & its disadvantages, vacuum efficiency and condenser efficiency, Problems.

Unit VII **Air Compressors:** Working of a single stage reciprocating air compressor; calculation of work input; Volumetric efficiency; Isothermal efficiency; Advantages of multi stage compression; Two stage compressor with Inter-cooling; Perfect Inter cooling; Optimum intercooler pressure, Problems.

Course Outcomes:

1. Calculate air-fuel ratio for combustion of different fuels and estimate the amount of flue gases in exhaust.
2. Explain the construction and working of different steam boilers and estimate their performance.
3. Explain the steam power plant components with the help of basic and advanced cycles.
4. Calculate the performance of steam nozzle, steam turbine, steam condenser, and steam condenser.

Text Books:

1. Thermal Engineering – P L Ballaney, Khanna Publishers
2. Thermodynamics and Heat Engines vol. II – R Yadav, Central Publishing House

Reference Books:

1. Applied Thermodynamics for Engineering Technologists – T D Eastop and A McConkey, Pearson Education.
2. Heat Engineering – V P Vasandani and D S Kumar, Metropolitan Book Co Pvt Ltd.

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

ME- 212 E (MATERIAL SCIENCE LAB)

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Understand structure-properties properties relationship
2. Understand the mechanical behavior of materials, phase & phase diagram, heat treatment, failure of materials & their protection, applications of recent materials.
3. Develop intuitive understanding of the subject to present a wealth of real world engineering examples to give students a feel of how material science is useful in engineering practices.

List of Experiments:

1. To study crystal structures of a given specimen.
2. To study crystal imperfections in a given specimen.
3. To study microstructures of metals/ alloys.
4. To prepare solidification curve for a given specimen.
5. To study heat treatment processes (hardening and tempering) of steel specimen.
6. To study microstructure of heat-treated steel.
7. To study thermo-setting of plastics.
8. To study the creep behavior of a given specimen.
9. To study the mechanism of chemical corrosion and its protection.
10. To study the properties of various types of plastics.
11. To study Bravais lattices with the help of models.
12. To study crystal structures and crystals imperfections using ball models.

Course Outcomes:

1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials.
2. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
3. Understand and suggest the heat treatment process & types.
4. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Note:

1. ***At least ten experiments are to be performed in the semester.***
2. ***At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.***

ME- 214 E (FLUID MECHANICS LAB)

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. To understand flow discharge measuring device used in pipes channels.
2. To determine fluid and flow properties.
3. To Characterize laminar and turbulent flows.

List of Experiments:

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoullis Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.

Course Outcomes:

1. Determine flow discharge measuring device used in pipes channels.
2. To understand about fluid and flow properties.
3. To distinguish between laminar and turbulent flows.

Note:

1. ***At least ten experiments are to be performed in the semester.***
2. ***At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.***

ME- 216 E (ENERGY CONVERSION LAB)

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Provide knowledge of various components of Steam Power Plant.
2. Know working Principle of boilers, turbines and other steam power plant components.
3. Basically uses all the applications of steam & its measurements leading to Thermal Power Plant using any fuel.

List of Experiments:

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction of steam by separating and throttling calorimeter.
6. To find power output & efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study and find volumetric efficiency of a reciprocating air compressor.
9. To study cooling tower and find its efficiency.
10. To find calorific value of a sample of fuel using Bomb calorimeter.
11. Calibration of Thermometers and pressure gauges.

Course Outcomes:

1. Operation of various types of boilers
2. Calculate power and efficiency of different components of steam power plant
3. Measure the calorific values and dryness fraction
4. Conduct performance test on reciprocating air compressor.

Note:

1. ***At least ten experiments are to be performed in the semester.***
2. ***At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.***

UCC-581 (ENVIROMENTAL STUDIES)

L	T	P	Credit
4	---	---	---

Unit 1: The multidisciplinary nature of environmental studies

Definition, scope and importance.
Need for public awareness.

Unit 2: Natural Resources

Renewable and non-renewable resources:
Natural resources and associated problems:

1. Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people.
2. Water resources: Use and over-utilization of surface and ground water, floods, drought conflicts over water, dams-benefits and problems.
3. Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources, case studies.
4. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
5. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
6. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
    a. Role of an individual in conservation of natural resources.
    b. Equitable use of resources for sustainable lifestyle.

Unit 3: Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem:
    a) Forest ecosystem
    b) Grassland ecosystem
    c) Desert Ecosystem
    d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Unit 4: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, national and local level.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.

- Endangered and endemic species of India.

Unit 5: Environmental Pollution.

- Definition
- Causes, effects and control measure of:
  a. Air pollution
  b. Water pollution
  c. Soil pollution
  d. Marine pollution
  e. Noise pollution
  f. Thermal pollution
  g. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

Unit 6: Social issues and the Environment.

- From Unsustainable to Sustainable development.
- Urban problems related to energy.
- Water conservation, rain water harvesting, watershed management.
- Resettlement and rehabilitation of people; its problems and concerns, Case studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Unit 7: Human Population and the Environment.

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

Unit 8: Field Work

- Visit to a local area to document environmental assets-river/forests/grassland/hill/mountain.
- Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems – pond, river, hill slopes etc.

INSTRUCTIONS FOR THE EXAMINERS

Part – A Question 1 is compulsory and will contain ten short-answer type questions of 2.5 marks each covering the entire syllabus.

Part – B Eight essay type questions (with inbuilt choice) will be set from the entire syllabus and the candidates will be required to answer, any four of them.

The marks obtained in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these will be shown in the detailed marks certificates of the student.

Scheme & Syllabi

For

B.Tech. 3rd year

Department of Mechanical Engineering
Guru Jambheshwar University of Science & Technology, Hisar

FIFTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-301-E	Kinematics of Machines	3	1	-	3.5
ME-303-E	Machine Design-I	3	1	-	3.5
ME-305-E	Fluid Machines	3	1	-	3.5
ME-307-E	Internal Combustion Engines & Gas Turbnes	3	1	-	3.5
ME-309-E	Manufacturing Sciences	3	1	-	3.5
ME-311-E	Applied Numerical Techniques& Computing	3	1	-	3.5
ME-313-E	Kinematics of Machines Lab	-	-	2	1.0
ME-315-E	Fluid Machines Lab	-	-	2	1.0
ME-317-E	Internal Combustion Engines & Gas Turbnes Lab	-	-	2	1.0
ME-319-E	Applied Numerical Techniques& Computing Lab	-	-	2	1.0
ME-321-E	Practical Training-I	-	-	2	1.0
				TOTAL	**26.0**

SIXTH SEMESTER

CODE	Subject	L	T	P	CREDIT	
ME-302-E	Dyanamics of Machines	3	1	-	3.5	
ME-304-E	Machine Design-II	3	1	-	3.5	
ME-306-E	Heat Transfer	3	1	-	3.5	
ME-308-E	Automatic Controls	3	1	-	3.5	
ME-310-E	Measurements & Instrumentation	3	1	-	3.5	
ME-312-E	Industrial Engineering	3	1	-	3.5	
ME-314-E	Dyanamics of Machines Lab	-	-	2	1.0	
ME-316-E	Heat Transfer Lab	-	-	2	1.0	
ME-318-E	Measurements & Instrumentation Lab	-	-	2	1.0	
ME-320-E*	Professional Practices(Proficiency)*	-	-	-	0.0	
				TOTAL	**24.0**	

indicates Non-Credit paper, not counted towards calculation of SGPA/CGPA/Total Marks.

Total Credits=50

ME-301 E (KINEMATICS OF MACHINES)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

4. To impart knowledge on various types of mechanisms and synthesis.
5. To impart skills to analyze the position, velocity and acceleration of mechanisms.
6. To familiarize higher pairs like cams and gears.

Unit I **Introduction:** mechanism and machines, kinematic links, kinematic pairs, kinematic chains, plane and space mechanism, kinematic inversion, equivalent linkages, four link planar mechanisms, mobility and range of movement, straight line mechanisms, steering mechanisms, pantograph, problems.

Unit II **Kinematic Analysis of Plane Mechanisms:** displacement analysis, general plane motion, instantaneous center of velocity, graphical and analytical methods of velocity and acceleration analysis, problems.

Unit III **Cams:** classification of cams and followers, disc cam nomenclature, construction of displacement, velocity and acceleration diagrams for different types of follower motions, analysis of follower motions, determination of basic dimension, synthesis of cam profile by graphical and analytical approaches, cams with specified contours, tangent and circular are cams, problems.

Unit IV **Gears:** fundamental law of gearing, involute spur gears, characteristics of involute action, Interference and undercutting, center distance variation, involutometry, non-standard gear teeth, helical, spiral bevel and worm gears, problems.

Unit V **Gear Trains:** synthesis of simple, compound and reverted gear trains, analysis of epicycle gear trains, problems.

Unit VI **Kinematic synthesis of Mechanisms:** Type, number and dimensional synthesis, function generation, path generation and body guidance two and three position synthesis of four bar and slider crank mechanisms by graphical and analytical methods, Freudenstein's equation, precision positions, structural error; Chebychev spacing, transmission angle, problems.

Unit VII **Kinematics of Spatial Mechanisms:** introduction, link coordinate system, homogeneous transformation matrix, loop closure equation, kinematics of robotic manipulators, problems.

Course Outcomes:

4. Understand common mechanisms used in machines and everyday life.
5. Calculate mobility (number of degrees of freedom) and enumerate rigid links and types of joints within mechanisms.
6. Understand various cam motion profiles and follower mechanism, their classification and design based on the prescribed follower motion (SHM, Uniform Velocity and Acceleration, Cycloidal)

7. Understand gear mechanism classification and to become familiar with gear standardization and specification in design.
8. Understand importance of gear trains and their practical applications.

Text Books:

1. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, MGH, New York.

Reference Books:

1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati Second Edition New age International.
2. Theory and Machines: S.S. Rattan, Tata McGraw Hill.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME- 303 E (MACHINE DESIGN –I)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

Provide students with the ability to apply design procedure with specific design tools representing empirical, semi-empirical and analytical approaches.

Unit I **Design Philosophy:** Problem identification- problem statement, specifications, constraints, Feasibility study-technical feasibility, economic & financial feasibility, societal & environmental feasibility, Generation of solution field (solution variants), Brain storming, Preliminary design, Selection of best possible solution, Detailed design, Selection of Fits and tolerances and analysis of dimensional chains.

Unit II **Selection of Materials:** Classification of Engg. Materials, Mechanical properties of the commonly used engg. Materials, hardness, strength parameters with reference to stress-strain diagram, Factor of safety.

Unit III **Mechanical Joints:** ISO Metric Screw Threads, bolted joints in tension, eccentrically loaded bolted joints in shear and under combined stresses, Design of power screws, Design of various types of welding joints under different static load conditions.

Unit IV **Riveted Joints, Cotter & Knuckle Joints:** Design of various types of riveted joints under different static loading conditions, eccentrically loaded riveted joints, design of cotter and knuckle joints.

Unit V **Belt rope and chain drives:** Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives, design of chain drives with sprockets.

Unit VI **Keys, Couplings & Flywheel:** Design of Keys – Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, design of flywheel – solid disk & rimmed flywheels.

Unit VII **Clutches:** Various types of clutches in use, Design of friction clutches – Disc. Multidisc, Cone & Centrifugal, Torque transmitting capacity.

Unit VIII **Brakes:** Various types of Brakes, Self energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

Course Outcomes:

1. Learn the basics elements of hydroelectric power plant and their layout.
2. Conduct a failure analysis for the design/sizing of mechanical components
3. Calculate stresses involved with static/ fatigue loading
4. Design and analyses a real engineering system through projects
5. Represent machine elements with a free body diagram and solve for unknown reactions
6. Select the suitable materials and manufacturing considerations.

Text Books:

1. Mechanical Engg. Design - First Metric Editions: Joseph Edward Shigley-MGH, New York.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
3. PSG Design Data Book

Reference Books:

1. Engineering design – George Dieter, MGH, New York.
2. Product Design and Manufacturing, A.K.Chitale and R.C.Gupta, PHI.
3. Machine Design An Integrated Approach: Robert L.Norton, Addison Wesley.
4. Machine Design: S.G. Kulkarini - Tata MacGraw Hill.
5. Design of machine elements-C S Sharma, Kamlesh Purohit, PHI.

Note:

1. ***In the semester examination the examiner will set 8 questions, at least one question fromeach unit. Students will be required to attempt 5 questions.***
2. ***The paper setter will be required to mention in the note in the question paper that the use of only PSG Design Data book is permitted.***

ME- 305 E (FLUID MACHINES)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Provide fundamentals of impact of jet.
2. Complete detail of hydroelectric power plant unit.
3. Explain, analyze and design the fluid machinery elements like Turbines (Impulse and Reaction) Pumps: reciprocating and centrifugal, other fluid systems like hydraulic jack, hydraulic couplings, torque converter etc.

Unit I **Impact of free jets:** Impulse – momentum principle, jet impingement - on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vans and a series of vanes, Jet striking tangentially at the tip of a stationary vane and moving vane(s), jet propulsion of ships. Problems

Unit II **Impulse Turbines:**Classification – impulse and reaction turbines, water wheels, component parts, construction, operation and governing mechanism of a Pelton wheel, work done, effective head, available head and efficiency of a Pelton wheel, design aspects, speed ratio, flow ratio, jet ratio, number of jets, number of buckets and working proportions, Performance Characteristics, governing of impulse turbines. Problems

Unit III **Francis Turbines:**Component parts, construction and operation of a Francis turbine, governing mechanism, work done by the turbine runner, working proportions and design parameters, slow, medium and fast runners, degree of reaction, inward/outward flow reaction turbines, Performance Characteristics, Problems.

Unit IV **Propeller and Kaplan turbines:**Component parts, construction and operation of a Propeller, Kaplan turbine, differences between the Francis and Kaplan turbines, draft tube - its function and different forms, Performance Characteristics, Governing of reaction turbine, Introduction to new types of turbine, Deriaz (Diagonal), Bulb, Tubular turbines, Problems.

Unit V **Dimensional Analysis and Model Similitude:**Dimensional homogeneity, Rayleigh's method and Buckingham's π-theorem, model studies and similitude, dimensionless numbers and their significance. Unit quantities, specific speed and model relationships for turbines, scale effect, cavitations – its causes, harmful effects and prevention, Thomas cavitation factor, permissible installation height, Problems.

Unit VI **Centrifugal Pumps:**Classification, velocity vector diagrams and work done, monomeric efficiency, vane shape, head capacity relationship and pump losses, pressure rise in impeller, minimum starting speed, design considerations, multi-stage pumps. Similarity relations and specific speed, net positive suction head, cavitation and maximum suction lift, performance characteristics. Brief introduction to axial flow, mixed flow and submersible pumps, Problems.

Unit VII **Reciprocating Pumps:**Construction and operational details, discharge coefficient, volumetric efficiency and slip, work and power input, effect of acceleration and friction on indicator diagram (pressure – stroke length plot), separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank,

characteristic curves, centrifugal vs reciprocating pumps, brief introduction to screw, gear, vane and radial piston pumps, Problems.

Unit VIII **Hydraulic systems:**Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic ram, Problems.

Course Outcomes:

1. Apply the fundamentals of impact of jet to various hydraulic machines.
2. Develop an overview of hydroelectric power plant and its components.
3. Solve problems related to hydraulics turbines and pumps.
4. Learn basic principles, construction and working of different hydraulic systems.

Text Books:

1. Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi
2. Hydraulic Machines – Jagdish Lal, Metropolitan

Reference Books:

1. Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers
2. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill
3. Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons

***Note: In the semester examination the examiner will set 8 questions, at least one question from each* Unit. Students will be required to attempt 5 questions.**

ME- 307 E (INTERNAL COMBUSTION ENGINES & GAS TURBINES)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Acquire the knowledge of engine components and fuel air cycles.
2. Understand the working of engine auxiliary systems.
3. Understand the combustion aspects of SI & CI Engines
4. Know the various alternate fuels, engine emissions, measuring and control techniques.
5. Understand the basic concepts of rotary compressor and gas turbines.

Unit – I **Air Standard Cycles:** Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

Unit – II **Carburetion, fuel Injection and Ignition systems:** Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems.

Unit – III **Combustion in I.C. Engines:** S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.

Unit – IV **Lubrication and Cooling Systems:** Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

Unit – V **Engine Testing and Performance:** Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems.

Unit – VI **Air pollution from I.C. Engine and Its remedies:** Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

Unit – VII **Rotary Compressors:** Root and vane blowers; Static and total head values; Centrifugal compressors- Velocity diagrams, slip factor, ratio of compression, pressure coefficient, pre-whirl; Axial flow compressor- Degree of reaction, polytrophicefficiency, surging, choking and stalling, performance characteristics, Problems.

Unit – VIII **Gas Turbines**: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multi stage compression with inter-cooling; multi stage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems.

Course Outcomes:

1. Understand and analyze the phenomenon of combustion in IC engines (SI and CI engines).
2. Understand the emission standards for SI and CI engines.
3. Appraise the open and closed types of gas turbines.
4. Understand the centrifugal compressor and its working.

Text Books:

1. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
2. Gas Turbines - V. Ganesan, Pub.- Tata McGraw Hill.
3. Engineering fundamental of the I.C. Engine – Willard W. Pulkrabek Pub.-PHI,India

Reference Books:

1. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York.
2. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME- 309 E MANUFACTURING SCIENCE

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic overview of Mechanism of Metal Cutting & cutting tool material with it's phenomena.
2. To study gear manufacturing & gear finishing operation.
3. To impart in depth knowledge of unconventional machining processes with their application.
4. To expose the students to the jigs & fixtures.
5. To impart knowledge to the students about manufacturing accuracy, tolerance analysis, metrology & testing of machine tools.

Unit I **Mechanism of Metal Cutting:** Deformation of metal during machining, nomenclature of lathe, milling tools, mechanics of chip formation, built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal cutting, factors affecting tool forces. Cutting speed, feed and depth of cut, surface finish. Temperature distribution at tool chip interface. Numericals on cutting forces and Merchant circle.

Unit II **Cutting Tool Materials & Cutting Fluids:** Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid.

Unit III **Tool Wear and Machinability:** Types of tool wear, tool life, factors governing tool life, Machinability: Definition and evaluation. Economics of machining. Numericals on tool life.

Unit IV **Gear Manufacturing:** Introduction, methods of manufacture. Gear generation and forming: Gear cutting by milling, single point form tool, gear hobbing and shaping. Gear finishing operations: Gear shaving, gear burnishing, gear grinding, lapping.

Unit V **Unconventional Machining Processes:** Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electro-chemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining: Generation of electron beam, relative merits and demerits. Laser beam machining: Principles and applications.

Unit VI **Jigs & Fixtures:** Introduction, location and location devices, clamping and clamping devises, Drill Jigs, Milling Fixtures.

Unit VII **Manufacturing Accuracy:** Product cycle inmanufacturing, part print analysis, location principles, tolerance stacking, accuracy of machining, operation selection, tolerance analysis.

Unit VIII **Metrology & Machine Tools Testing:** Tolerances, limits and fits, methods of linear measurement and angular measurement, Go and No Go gauges. Introduction to Machine tools testing**,** measuring instruments used for testing, test procedures, acceptance tests of machine tools.

Course Outcomes:

1. Identify Mechanism of Metal Cutting & can Understand Cutting Tool Materials with it's phenomena.
2. Understand gear manufacturing & gear finishing operation.
3. Understand the working and applications unconventional machining processes
4. Understand the jigs & fixtures.
5. Understand the manufacturing accuracy, tolerance analysis, metrology & machine tools testing.

Text Books

1. Manufacturing Technology – Metal cutting and machine Tools: P.N. Rao, T.M.H, New Delhi
2. Introduction to Jig and Tool Design: Kempster M.H.A, Hodder & Stoughton, England

Reference Books

1. Principles of Machine Tools – G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
2. Manufacturing Engg.& Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
3. Modern Machining Processes: P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
4. Text Book of Production Engineering: P.C. Sharma, S.Chand & Sons.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt 5 questions.

ME – 311 E APPLIED NUMERICAL TECHNIQUES AND COMPUTING

L	T	P	Credit
3	1	----	3.5

Course Objectives:

The course is aimed to provide elementary knowledge of numerical methods and statistical techniques and enable students to apply various tools and techniques to solve problems in engineering and science.

Unit – I **Errors in Numerical Calculations:** Introduction, Numbers and their accuracy, Absolute, relative and percentage errors and their analysis, General error formula.

Unit – II **Interpolation and Curve Fitting:** Taylor series and calculation of functions, Introduction to interpolation, Lagrange approximation, Newton Polynomials, Chebyshev Polynomials, least squares line, curve fitting, Interpolation by spline functions.

Unit – III **Numerical Differentiation and Integration:** Approximating the derivative, Numerical differentiation formulas, Introduction to Numerical quadrature, Newton-Cotes formula, Gaussion Quadrature.

Unit – IV **Solution of Nonlinear Equations:** Bracketing methods for locating a root, Initial approximations and convergence criteria, Newton- Raphson and Secant methods, Solution of problems through a structural programming language such as C or Pascal.

Unit – V **Solution of Linear Systems:** Direct Methods, Gaussian elimination and pivoting, Matrix inversion, UV factorization, Iterative methods for linear systems, Solution of problems through a structured programming language such as C or Pascal.

Unit – VI **Eigen Value Problems:**Jacobi, Given's and Householder's methods for symmetric matrices, Rutishauser method for general matrices, Power and inverse power methods.

Unit – VII **Solution of Differential Equations:** Introduction to differential equations, Initial value problems, Euler's methods, Heun's method, Runge-Kutta methods, Taylor series method, Predictor-Corrector methods, Systems of differential equations, Boundary valve problems, Finite-difference method, Solution of problems through a structured programming language such as C or Pascal.

Unit – VIII **Partial Differential Equations, Eigenvalues and Eigenvectors:**Solution of hyperbolic, parabolic and elliptic equations, The eigenvalue problem, The power method and the Jacobi's method for eigen value problems, Solution of problems through a structural programming language such as C or Pascal.

Course Outcomes:

1. Be aware of the use of numerical methods in modern scientific computing,

2. Be familiar with programming with numerical packages like MATLAB.

Text Books:

1. Numerical Methods for Mathematics, Science and Engineering by John H.Mathews, PHI New Delhi.
2. Applied Numerical Methods – Carnahan, B.H., Luthar, H.A. and Wilkes, J.O., Pub.- J. Wiley, New York.

Reference Books:

1. Numerical Solution of Differential Equations, by M.K. Jain, Published by Wiley Eastern, New York.
2. Introductory Methods of Numerical Analysis by S.D. Sastry, Published by Prentice Hall of India.
3. Numerical Methods – Hornbeck, R.W. , Pub.- Prentice Hall, Englewood Cliffs, N.J.

Note:

1. Programming exercises may be done in MATLAB.
2. The Instructor of the course may cover the use of software MATHEMATICA in the tutorial class.
3. In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attend only 5 questions.

ME- 313 E KINEMATICS OF MACHINES LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Impart the knowledge on link, pair, kinematic chain, mechanism, and inversions of different types of chains.
2. To familiarize with different types of cams and followers, and their applications.
3. To expose students to different types of gears and gear trains, and their applications.

List of Experiments:

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study various type of camand follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.
7. To generate spur gear involute tooth profile using simulated gear shaping process.
8. To study various types of gears – Helical, cross helical worm, bevel gear.
9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
10. To find co-efficient of friction between belt and pulley.
11. To study the working of Screw Jack and determine its efficiency.
12. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.
13. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.
14. To design a cam profile by using the requirement graph using on-line engineering handbook and verify the same using a 3D mechanism on CAD.

Course Outcomes:

1. Understand concept of link, pair, kinematic chain and mechanism.
2. Understand inversions and inversions of different types of kinematic chains.
3. Draw cam profiles and understand their applications.
4. Understand importance of gears, gear trains and their practical applications.

Note:

1. ***At least ten experiments are to be performed in the Semester.***
2. ***At least eight experiments should be performed from the above list. However these experiments should include experiments at Sr. No. 12, 13 and 14. Remaining two experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus.***

ME- 315 E FLUID MACHINES LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Understand the basics of hydroelectric power plant and their operations.
2. Provide fundamental details, construction and working of various fluid machinery elements like Turbines, Pumps and other fluid systems.
3. Analyze the performance of various fluid machinery elements like Turbines (Impulse and Reaction), Pumps: reciprocating and centrifugal, other fluid systems like hydraulic jack, hydraulic couplings, torque converter etc.

List of Experiments:

1. To study the constructional details of a Pelton turbine and draw its fluid flow circuit.
2. To draw the following performance characteristics of Pelton turbine-constant head, constant-speed and constant efficiency curves.
3. To study the constructional details of a Francis turbine and draw its fluid flow circuit.
4. To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.
5. To study the construction details of a Kaplan turbine and drawits fluid flow circuit.
6. To draw the constant head, speed and efficiency curves for a Kaplan turbine.
7. To study the constructional details of a Centrifugal Pump and draw its characteristic curves.
8. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.
9. To study the construction details of a Gear oil pump and its performance curves.
10. To study the constructional details of a Hydraulic Ram and determine its various efficiencies.
11. To study the constructional details of a Centrifugal compressor.
12. To study the model of Hydro power plant and draw its layout.

Course Outcomes:

1. Learn the basics elements of hydroelectric power plant and their layout.
2. Get a complete awareness on hydraulic machines and flow measuring instruments.
3. Operate hydraulic machines and evaluate their performance.

NOTE:

1. ***At least ten experiments are to be performed in the Semester.***
2. ***At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.***

ME- 317 E IINTERNAL COMBUSTION ENGINES & GAS TURBINES LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. To study the constructional and working details of 4 stroke and 2 stroke petrol and diesel engines.
2. Learn how to determine the power (IP & BP), fuel consumption, efficiency (thermal and volumetric) of 2 stroke and 4 stroke petrol engines.
3. Learn how to determine the power (IP & BP), fuel consumption, efficiency (thermal and volumetric) of 4 stroke multi-cylinder petrol engine.
4. To draw heat balance sheet of petrol and diesel engines.
5. To measure CO and hydrocarbons in the exhaust of petrol engines.

List of Experiments:

1. To study the constructional details & working principles of two-stroke/ four stroke petrol engine.
2. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
3. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat
4. Apparatus.
5. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
6. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
7. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp,fhp, vs speed (ii) volumetric efficiency&indicated specific fuel consumption vs speed.
8. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & by motoring method.
9. To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and A/F and (ii) bhp vs mep, mech efficiency & sfc.
10. To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.
11. To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.
12. To draw the scavenging characteristic curves of single cylinder petrol engine.
13. To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.

Course Outcomes:

1. Understand the working of petrol and diesel engines.
2. Perform internal combustion engine (Petrol/Diesel) test to measure power, efficiency, fuel consumption and emissions.

NOTE:

1. ***At least ten experiments are to be performed in the Semester.***
2. ***At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.***

ME- 319 E APPLIED NUMERICAL TECHNIQUES AND COMPUTING LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

The course is aimed to provide elementary knowledge of numerical methods and statistical techniques and enable students to apply various tools and techniques to solve problems in engineering and science.

List of Experiments:

1. Solution of Non-linear equation in single variable using the method of successive bisection.
2. Solution of Non-Linear equation in single variable using the Newton Raphson, Secant, Bi – Section and Modified Euler's, method.
3. Solution of a system of simultaneous algebraic equations using the Gaussian elimination procedure.
4. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method.
5. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method employing the technique of successive relaxation.
6. Numerical solution of an ordinary differential equation using the Euler's method.
7. Numerical solution of an ordinary differential equation using the Runge - Kutta 4th order method.
8. Numerical solution of an ordinary differential equation using the Predictor – corrector method.
9. Numerical solution of a system of two ordinary differential equation using Numerical integration.
10. Numerical solution of an elliptic boundary value problem using the method of Finite Differences.

Course Outcomes:

1. Be aware of the use of numerical methods in modern scientific computing,

2. Be familiar with programming with numerical packages like MATLAB.

Note: The students will be required to carry out the following exercises, that are based on the theory course ME-311 Numerical Methods and Computing, with the help of MATLAB software / Pascal / C / C++ on personal computer.

ME – 321 E PRACTICAL TRAINING – I

L	T	P	Credit
---	---	2	1.0

Course Objectives:

This course aims to provide the students Industrial exposure with their academics. The objective of this course is to relate subject knowledge with Industry operations. This course will be helpful to enhance the practical knowledge of the students.

At the end of fourth semester each student would undergo six weeks Practical Training in an industry/ Professional organization / Research Laboratory with the prior approval of the Director-Principal/ Principal of the concerned college and submit a written typed report along with a certificate from the organization. The report will be a evaluated during V Semester by a Board of Examiners to be appointed by the Director-Principal/ Principal of the concerned college who will award one of the following grades:

Excellent	:	A
Good	:	B
Satisfactory	:	C
Not satisfactory	:	F

A student who has been awarded 'F' grade will be required to repeat the practical training.

Course Outcomes:

1. The students at the end of Training will learn how to work in an Industrial work culture.
2. Presentation and communication skills are enhanced after this course.
3. The students will come to know the practical aspects of mechanical Engineering after doing Practical Training.
4. This course also teaches the students to do the project work in a team.

ME- 302 E DYNAMICS OF MACHINES

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. Impart the knowledge on principles and operations of dynamometers and governors.
2. Expose the students to gyroscopic couple and its effects.
3. Relate static and dynamic balancing analysis as applied to machines.

Unit I **Static and Dynamic Force Analysis:** Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.

Unit II **Dynamics of Reciprocating Engines:**Engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces.

Unit III **Balancing of Rotating Components:**Static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of rotors, balancing machines, field balancing.

Unit IV **Balancing of Reciprocating Parts:** Balancing of single cylinder engine, balancing of multi cylinder; inline, radial and V type engines, firing order.

Unit V **Governors:**Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors.

Unit VI **Dynamometers:**Types of dynamometers, Prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer.

Unit VII **Gyroscope:**Gyroscopes, gyroscopic forces and couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.

Course Outcomes:

1. Analyze and design centrifugal governors.
2. Understand different types of dynamometers and applications.
3. Understand the gyroscopic effects in ships, aero planes and road vehicles.
4. Analyze balancing problems in rotating and reciprocating machinery.

Text Books:

1. Theory of Mechanisms and Machines: Amitabha Ghosh and Ashok kumar Mallik, Third Edition Affiliated East-West Press.
2. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Second Edition, Mc Graw Hill, Inc.

Reference Books:

1. Mechanism and Machine Theory: J.S. Rao and R.V. Dukkipati, New age International.
2. Theory and Machine (S I units) S.S. Rattan, Tata McGrawHill.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME- 304 E MACHINE DESIGN –II

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. To expose the students to the Design for Production and for variable loading.
2. To impart in depth knowledge of designing of shafts.
3. To impart knowledge of spring and design for different types of spring.
4. To design bearings, selection of bearings for different aspects & lubricants with their properties.
5. To impart in depth knowledge of gears, design of different types of gears with consideration of maximum power transmission and gear lubrication.

Unit I **Design for Production:**Ergonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining. Variable Loading : Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

Unit II **Shafts:** Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration.

Unit III **Springs:** Types of Springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem.

Unit IV **Bearings:**Design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

Unit V **Gears:** Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth -Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

Course Outcomes:

1. Identify Design for Production and for variable loading.
2. Understand designing of shafts.
3. Understand spring and design for different types of spring.

4. Understand designing of bearings, selection of bearings for different aspects & lubricants with their properties.
5. Understand the gears, design of different types of gears with consideration of maximum power transmission and gear lubrication.

Text Books:

1. Mechanical Engg. Design- Joseph Edward Shigley-Mc Graw Hill Book Co.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.

Reference Books:

1. Engineering design – George Dieter, McGraw Hill, New York.
2. Product Design and Manufacturing –: A.K.Chitale and R.C.Gupta, PHI, New Delhi.
3. Machine Design an Integrated Approach: Robert L.Norton, Second Edition –Addison Wisley Longman
4. Machine Design: S.G. Kulkarni , TMH , New Delhi.

Note:

1. ***In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.***
2. ***The paper setter will be required to mention in the note of the question paper that the use of only PSG Design Data book is permitted.***

ME –306E HEAT TRANSFER

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. To understand the concept and basic laws of conduction (steady and transient), convection (free and forced) and radiation (thermal) heat transfer.
2. To analyze the phase change heat transfer.
3. Sizing of heat exchangers.

Unit I **Basics and Laws:** Definition of Heat Transfer, Reversible and irreversibleprocesses, Modes of heat flow, Combined heat transfer system and law of energy conservation.

Unit II **Steady State Heat Conduction:** Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, Conduction equation in Cartesian, polar and spherical co-ordinate systems, Numericals.

Unit III **Steady State Conduction with Heat Generation:** Introduction, 1 – D heat conduction with heat sources, Extended surfaces (fins), Fin effectiveness 2-D heat conduction, Numericals.

Unit IV **Transient Heat Conduction:** Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Chart solution, Relaxation Method, Numericals.

Unit V **Convection:** Forced convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations, Some results for flow over a flat plate and flow through tube, Fluid friction and heat transfer (Colburn analogy), Free convection from a vertical flat plate, Empirical relations for free convection from vertical and horizontal o\planes & cylinders, Numericals.

Unit VI **Thermal Radiation:** The Stephen-Boltzmann law, The black body radiation, Shape factors and their relationships, Heat exchange between non black bodies, Electrical network for radiative exchange in an enclosure of two or three gray bodies, Radiation shields, Numericals.

Unit VII **Heat Exchangers:** Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, Numericals.

Unit VIII **Heat Transfer with Change of Phase:** Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Free convective, Nucleate and film boiling, Numericals.

Course Outcomes:

1. Appraise the conduction, convection and radiation mode of heat transfer through various applications.
2. Evaluate heat transfer for forced and free convection applications.
3. Calculate the parameters of heat exchangers, condensers and evaporator using LMTD and NTU Methods for various applications.
4. Explain the radiation heat transfer problems.
5. Apply principles of heat transfer to basic thermal engineering systems.

Text Books:

1. Heat Transfer – J.P. Holman, John Wiley & Sons, New York.
2. Fundamentals of Heat & Mass Transfer–Incropera, F.P. & Dewill, D.P –John Willey New York.

Reference Books:

1. Conduction of Heat in Solids – Carslow, H.S. and J.C. Jaeger – Oxford Univ. Press.
2. Conduction Heat Transfer – Arpasi, V.S. – Addison – Wesley.
3. Compact Heat Exchangers – W.M. Keys & A.L. Landon, Mc. Graw Hill.
4. Thermal Radiation Heat Transfer – Siegel, R. and J.R. Howell, Mc. Graw Hill.
5. Heat Transmission – W.M., Mc.Adams , Mc Graw Hill.

NOTE:

1. ***In the semester examination, the examiner will set Eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.***
2. ***The paper setter will be required to mention in the noteof question paper that the use of Steam tables, Charts, Graphical plots is permitted.***

ME- 308 E AUTOMATIC CONTROLS

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. To impart interdisciplinary knowledge.
2. To make a bridge between mechanical, electronics, instrumentation, computer and controls field.
3. Response analysis and stability criteria of control system.

Unit I **Introduction And Applications:** Types of control systems ; Typical Block Diagram : Performance Analysis; Applications – Machine Tool Control, Boiler Control, Engine Governing, Aerospace Control, Active Vibration Control; Representation of Processes & Control Elements – Mathematical Modeling. Block Diagram Representation, Representation of Systems or Processes, Comparison Elements; Representation of Feedback Control systems – Block Diagram & Transfer Function Representation, Representation of a Temperature, Control System, Signal Flow Graphs, Problems.

Unit II **Types of Controllers:** Introduction: Types of Control Action; Hydraulic Controllers; Electronic Controllers; Pneumatic Controllers; Problems.

Unit III **Transient and Steady State Response:** Time Domain Representation; Laplace Transform Representation; System with Proportional Control; Proportional – cum – Derivative control; Proportional – cum – Integral Control; Error Constants; Problems.

Unit IV **Frequency Response Analysis:** Introduction; Closed and Open Loop Transfer Function; Polar Plots; Rectangular Plots; Nichols Plots: Equivalent Unity Feed Back Systems; Problems.

Unit V **Stability of Control Systems:** Introduction; Characteristic Equation; Routh's Criterion; Nyquists Criterion, Gain & Phase Margins: Problems.

Unit VI **Root Locus Method:** Introduction; Root Ioci of a Second Order System; General Case; Rules for Drawing Forms of Root Ioci; Relation between Root Locus Locations and Transient Response; Parametric Variation; Problems.

Unit VII **Digital Control System:** Introduction; Representation of Sampled Signal; Hold Device; Pulse Transfer Function; Block Diagrams; Transient Response; Routh's Stability Criterion; Root Locus Method; Nyquists Criterion; Problems.

Unit VIII **State Space Analysis of Control Systems:** Introduction; Generalized State Equation; Techniques for Deriving System State – Space Equations; Transfer Function from State Equations; Solution of State Vector Differential Equations; Discrete Systems; Problems.

Course Outcomes:

1. Students will be able to understand basic concepts of control systems
2. Understand the application of those principles in practice.
3. Understand the various components of Hydraulics/Pneumatics electro-pneumatic control systems
4. Stability criteria of various control system

Text Books:

1. Theory & Applications of Automatic Controls by B.C. Nakra, Published by New Age International Pvt. Ltd. Publishers, New Delhi.
2. Modern Control Engg. by Ugata, Prentice Hall of India, New Delhi.

Reference Books:

1. Automatic Control Systems by Kuo' Published by Prentice Hall of India, New Delhi.
2. Control System Engineering, I. J. Nagrath and M. Gopal, New Age, New Delhi.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME – 310 E MEASUREMENTS AND INSTRUMENTATION

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. To expose the students to the basic overview of measuring instruments along with the students static and dynamic properties of instruments.
2. To impart basic knowledge of transducers used in engineering field and to study various types of intermediate, indicating and recording elements used in measuring instruments.
3. To study commonly used motion, force, torque and flow measuring instruments used in engineering field.
4. To study the basic knowledge of various temperature measuring instruments and the statistical tools which are used to handle primary data of measuring instruments

Unit I **Instruments and Their Representation:** Introduction, Typical Applications of Instrument Systemsand Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration.

Unit II **Static and Dynamic characteristics of Instruments:** Introduction, Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Dead Band, Backlash, Drift, Formulation of Differential Equations for Dynamic Performance- Zero Order, First Order and Second order systems, Response of First and Second Order Systems to Step, Ramp, Impulse and Harmonic Functions.

Unit III **Transducer Elements:** Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric, Inductive Self Generating and Non-Self Generating Types, Electromagnetic, Electrodynamic, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, Piezo-Electric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Single Double and Four Active Arm Bridge Arrangements, Temperature Compensation, Balancing and Calibration, Ionisation Transducers, Mechano Electronic Transducers, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Volatic Transducers, Digital Transducers, Frequency Domain Transducer, Vibrating String Transducer, Binary codes, Digital Encoders.

Unit IV **Intermediate, Indicating and Recording Elements:** Introduction Amplifiers, Mechanical, Hydraulic, Pneumatic, Optical, Electrical Amplifying elements, Compensators, Differentiating and Integrating Elements, Filters, Classification of Filters, A-D and D-A Converters, Digital Voltmeters (DVMs), Cathode Ray Oscillo scopes (CROs), Galvanometric Recorders, Magnetic Tape recorders, Data Acquisition Systems, Data Display and Storage.

Unit V **Motion, Force and Torque Measurement:** Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices, Seismic Devices, Spring Mass & Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter.

Unit VI **Pressure and Flow Measurement:** Pressure & Flow Measurement, Introduction : Moderate Pressure Measurement, Monometers, Elastic Transducer, Dynamic Effects of

Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing, Quantity Meters, Positive Displacement Meters, Flow Rate Meters, Variable Head Meters, Variable Area Meters, Rotameters, Pitot-Static Tube Meter, Drag Force Flow Meter, Turbine Flow Meter, Electronic Flow Meter, Electro Magnetic Flow meter. Hot-Wire Anemometer.

Unit VII **Temperature Measurement:** Introduction, Measurement of Temperature, Non Electrical Methods – Solid Rod Thermometer, Bimetallic Thermometer, Liquid-in-Glass thermometer, Pressure Thermometer, Electrical Methods – Electrical Resistance Thermometers, Semiconductor Resistance Sensors (Thermistors), Thermo–Electric Sensors, Thermocouple Materials, Radiation Methods (Pyrometry), Total Radiation Pyrometer, Selective Radiation Pyrometer.

Unit VIII **Basic Statistical Concepts:** Types of Measured Quantities (Discrete and Continuous), Central Tendency of Data, Mode, Median, Arithmetic Mean, Best Estimate of true Value of Data, Measures of Dispersion, Range, Mean Deviation, Variance, Standard Deviation, Normal Distribution, Central Limit Theorem, Significance Test, Method of Least Squares, Graphical Representation and Curve Fitting of Data.

Course Outcomes:

1. Understand fundamental elements, classification and standards of measuring instruments and identifying statistical and dynamic characteristics of instruments.
2. Understand different types of transducers used in measuring instruments and the applications of intermediate, indicating and recording elements of different instruments.
3. Understand various motion, force, torque, pressure and flow meters measuring devices.
4. Understand various temperature measure instruments and basic statistical techniques used to handle the primary data of measuring instruments.

Text Books:

1. Measurement systems Application and Design. Ernest O. Doebelin, Tata McGraw Hill Edition (Fourth Edition) 2002.
2. Measurement and Instrumentation in Engineering, Francis S. Tse and Ivan E. Morse, Marcel Dekker.

Reference Books:

1. Principles of Measurement and Instrumentation – Alan S. Morris Prentice Hall of India.
2. Mechanical Measurements: T.G. Beckwith, W.L. Buck and R.D. Marangoni Addison Wesley.
3. Instrumentation, Measurement and Analysis – B.C. Nakra and K.K. Chaudhary, TMH.
4. Mechanical Measurements by D. S. Kumar, Kataria & Sons.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME- 312 E INDUSTRIAL ENGINEERING

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. Impart the knowledge of different types of plant layout and material handling
2. Familiarize with the concept of work study and method study
3. Impart the knowledge of work measurement and value engineering
4 To impart knowledge of the production planning and control, management information system and importance of product design and development.

Unit I **Definition of Industrial Engineering:** Objectives, Method study, Principle of motion economy, Techniques of method study -Various charts, THERBLIGS, Work measurement - various methods, time study PMTS, determining time, Work sampling, Numerical.

Unit II **Productivity & Workforce Management:** Productivity - Definition, Various methods of measurement, Factors effecting productivity, Strategies for improving productivity, Various methods of Job evaluation & merit rating, Various incentive payment schemes, Behavioural aspects, Financial incentives.

Unit III **Manufacturing Cost Analysis:** Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour, material, overhead in volume, rate & efficiency, Break even Analysis, Marginal costing & contribution, Numericals.

Unit IV **Materials Management:** Strategic importance of materials in manufacturing industries, Relevant costs, Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Purchase discounts, Sensitivity analysis, Inventory control systems - P,Q,Ss Systems, Service level, Stock out risk, determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED and three dimensional, Numericals.

Unit V **Quality Management:** Definition of quality, Various approaches, Concept of quality assurance systems, Costs o fquality, Statistical quality Control (SQC), Variables & Attributes, X, R, P & C - charts, Acceptance sampling, OC - curve, Concept of AOQL, Sampling plan - Single, Double & sequential, Introduction to TQM & ISO - 9000.

Unit VI **Production Planning & Control (PPC) :** Introduction to Forecasting - Simple & Weighted moving average methods, Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other decision areas, Decision options - Basic & mixed strategies, Master production schedule (MPS), scheduling Operations Various methods for line & intermittent production systems, Gantt chart, Sequencing - Ohnson algorithm for n-Jobs-2 machines, n- Jobs-3 machines, 2 Jobs n-machines, n-Jobs m-machines Various means of measuring effectiveness of PPC, Introduction to JIT, Numericals.

Unit VII **Management Information Systems (MIS):** What is MIS? Importance of MIS, Organizational &information systemstructure, Role of MIS in decision making, Data flow diagram, Introduction to systems analysis & design, Organizing information systems.

Unit VIII **Product Design and Development:** Various Approaches, Product life cycle, Role 3S's – Standardization, Simplification, Specialization, Introduction to value engineering and analysis, Role of Ergonomics in Product Design.

Course Outcomes:

1. Understand the importance and need of industrial engineering for optimizing the various resources used in industries.
2. Understand method study and work measurement analysis which is helpful in increasing productivity of the organization.
3. Understand different cost aspects of a product and break even analysis which is helpful in deciding selling price and profit of the product.
4. Understand the importance of the inventory management in industries, concept of production planning and control and its role in development of organization.
5. Understand the concept of quality management and various techniques which is helpful in optimization of man, machine and material.

Text Books:

1. Production & Operations Management - Chary, TMH, New Delhi.
2. Management Information Systems - Sadagopan, PHI New Delhi.
3. Modern Production Management – S.S. Buffa, Pub.- John Wiley.

Reference Books:

1. Operations Management - Schroeder, McGraw Hill ISE.
2. Operation Management - Monks, McGraw Hill ISE.
3. Production & Operations Management - Martinich, John Wiely SE.
4. Industrial & Systems Engineering - Turner, MIZE, CHASE, Prentice Hall Pub.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME- 314 E DYNAMICS OF MACHINE LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Impart the knowledge of different types of governors.
2. To familiarize with gyroscopic effect of two wheelers, four wheelers, and aircrafts.
3. To expose students to the concept of dynamometers and their applications.
4. To familiarize with static and dynamic balancing analysis as applied to machines.

List of Experiments:

1. To perform experiment on Watt and Porter Governors to prepare performance characteristic Curves, and tofind stability& sensitivity.
2. To perform experiment on Proell Governor to prepare performance characteristic curves, and to find stability& sensitivity.
3. To perform experiment on Hartnell Governor to prepare performance characteristic Curves, and to find stability & sensitivity.
4. To study gyroscopic effects through models.
5. To determine gyroscopic couple on Motorized Gyroscope.
6. To perform the experiment for static balancing on static balancing machine.
7. To perform the experiment for dynamic balancing on dynamic balancing machine.
8. Determine the moment of inertial of connectingrod by compound pendulum method and tri-flair suspension pendulum.

Course Outcomes:

1. Understand sensitiveness and stability of different types of governors.
2. Measure Gyroscopic torque.
3. Measure BHP using rope brake dynamometer.
4. Understand static and dynamic balancing.

Note:

1. ***Ten experiments are to be performed in the Semester.***
2. ***At least seven experiments should be performed from the above list. Remaining three experiments should be performed as designed& set by the concerned Institution as per the scopeof the syllabus.***

ME- 316 E HEAT TRANSFER LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. To understand the concept of conduction (steady), convection (free and forced) and radiation heat transfer.
2. To analyze the phase change heat transfer.
3. To know the parallel and counter-flow types heat exchangers.

List of Experiments:

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. To determine the thermal conductivity of a solid by the guarded hot plate method.
4. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
5. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.
6. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
7. To determine average heat transfer coefficient for externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
8. To measure the emmisivity of the gray body (plate) at different temperature and plot the variation of emmisivity with surface temperature.
9. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
10. To verify the Stefen-Boltzmann constant for thermal radiation.
11. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.
12. To study the two phases heat transfer unit.
13. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.
14. Design of Heat exchanger using CAD and verification using thermal analysis package eg. IDEA software etc.

Course Outcomes:

1. Perform steady state conduction, free and forced convection experiments.
2. Conduct radiation heat transfer experiment.
3. Study the performance of various types of heat exchangers.

Note:

1. ***At least ten experiments are to be performed in the semester.***
2. ***At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.***

ME- 318 E MEASUREMENTS & INSTRUMENTATION LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Expose the students to various measuring instruments and their properties used in engineering field.
2. Practice of study the working of different electromechanical instruments.
3. Impart the knowledge to study different characteristics of measuring instruments.

List of Experiments:

1. To study various Temperature Measuring Instruments and to Estimate their Response times.

    a. Mercury – in glass thermometer
    b. Thermocouple
    c. Electrical resistance thermometer
    d. Bio-metallic strip

2. To study the working of Bourdon Pressure Gauge and to check the calibration of the gauge in a dead-weight pressure gauge calibration set up.
3. To study a Linear Variable Differential Transformer (LVDT) and use it in a simple experimental set up to measure a small displacement.
4. To study the characteristics of a pneumatic displacement gauge.
5. To measure load (tensile/compressive) using load cell on a tutor.
6. To measure torque of a rotating shaft using torsion meter/strain gauge torque transducer.
7. To measure the speed of a motor shaft with the help of non-contact type pick-ups (magnetic or photoelectric).
8. To measure the stress & strain using strain gauges mounted on simply supported beam/cantilever beam.
9. To measure static/dynamic pressure of fluid in pipe/tube using pressure transducer/pressure cell.
10. To test experimental data for Normal Distribution using Chi Square test.
11. To learn the methodology of pictorial representation of experimental data and subsequent calculations for obtaining various measures of true value and the precision of measurement using Data acquisition system/ calculator.
12. Vibration measurement by Dual Trace Digital storage Oscilloscope.
13. To find out transmission losses by a given transmission line by applying capacitive /inductive load Process Simulator.

Course Outcomes:

1. Understand the basic elements and working principles of various precise measuring instruments.
2. Understand the calibration of different measuring instruments.
3. Understand the measurement of different physical properties.

Note:

1. At least ten experiments are to be performed in the Semester.

2. ***At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the Syllabus.***

ME 320-E PROFESSIONAL PRACTICES (PROFICIENCY)

L	T	P	Credit
---	---	---	0.0

Activities under this subject are to be decided by the department.

Scheme & Syllabi

for

B.Tech. Final year

Department of Mechanical Engineering
Guru Jambheshwar University of Science & Technology, Hisar

SEVENTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-401-E	Automobile Engineering	3	1	-	3.5
ME-403-E	Refrigeration & Air-conditioning	3	1	-	3.5
ME-405-E	Operation Research	3	1	-	3.5
ME-415-E	Mechanical Vibrations	3	1	-	3.5
ME (Refer to list attached)	Department Elective-I*	3	1	-	3.5
ME-407-E	Automobile Engineering Lab	-	-	2	1.0
ME-409-E	Refrigeration&Air-conditioning Lab	-	-	2	1.0
ME-411-E	Project (Starts)		-	4	2.0
ME-413-E	Practical Training-II	-	-	3	1.5
				TOTAL	**23.0**

EIGHTH SEMESTER

CODE	Subject	L	T	P	CREDIT
ME-402-E	Computer Aided Design & Manufacturing (CADM)	3	1	-	3.5
ME-404-E	Power Plant Engineering	3	1	-	3.5
ME (Refer to list attached)	Department Elective-II	3	1	-	3.5
ME (Refer to list attached)	Department Elective-III	3	1	-	3.5
ME-408-E	Computer Aided Design & Manufacturing (CADM) Lab	-	_	2	1.0
ME-410-E	Independent Study Seminar	-	-	4.0	2.0
ME-412-E	General Fitness for the Profession*	-	-	2.0	1.0
ME-414-E	Project-II	-	-	10	5.0
				TOTAL	**23.0**

TOTAL CREDITS OF ALL SEMESTERS = 200

ME- 401 E AUTOMOBILE ENGINEERING

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic overview of automobile and idea about drives of automobile with safety features of vehicles.
2. To provide to the students an understanding of clutch & power transmission of automobile.
3. To impart in depth knowledge drive lines, suspension system & steering system of automotive vehicles.
4. To impart knowledge to the students about automotive brakes, tyres & wheels.
5. To impart knowledge on the mechanisms involved in the starting systems, ignition systems and an emission control system of vehicles.

Unit I **Introduction to Automobiles:** Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

Unit II **Clutches :** Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

Unit III **Power Transmission :** Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases.

Unit IV **Drive Lines, Universal Joint, Differential and Drive Axles:** Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

Unit V **Suspension Systems:** Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.

Unit VI **Steering System:** Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

Unit VII **Automotive Brakes, Tyres & Wheels :** Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.

Unit VIII **Emission Control System & Automotive Electrical :** Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Course Outcomes:

1. Identify basic component of automobile & drives of automobile with safety features of vehicles.
2. Understand phenomena of clutches, power transmission & their different types.
3. Understand drive lines, suspension system, steering system of automotive vehicles
4. Understand different types of automotive brakes, tyres & wheels with their application.
5. Understand the mechanisms of starting systems, ignition systems and an emission control system of vehicles.

Text Books:

1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.

Reference Books:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automotive Technology – H.M. Sethi, TMH, New Delhi.
3. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
4. Automotive Mechanics – Joseph Heitner, EWP.
5. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
6. The Motor Vehicle – Newton steeds Garrett, Butter Worths.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions.

ME-403 E REFRIGERATION & AIR CONDITIONING

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To understand the principles and applications of refrigeration systems.
2. To understand vapour compression refrigeration system and identify methods for performance improvement.
3. To study the working principles of air, vapour absorption, thermoelectric and steam-jet refrigeration systems.
4. To analyze air-conditioning processes using the principles of psychrometry.
5. To evaluate cooling and heating loads in an air-conditioning system.

Unit I **Introduction:** Definition of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants- Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco-friendly Refrigerants; Introduction to Cryogenics.

Unit II **Air Refrigeration System:** Carnot refrigeration cycle. Temperature. Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems, problems.

Unit III **Vapour Compression (VC) Refrigeration Systems:**(A) Simple Vapour Compression (VC) Refrigeration Systems-Limitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

(B) Multistage Ref. Systems- Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

Unit IV **Other Refrigeration Systems:**(A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems.

(B) Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.

(C) Cascade Refrigerating Systems-Necessity Selection of Pairs of refrigerants for the system, Concept of cascade temperature, Analysis, Multistaging, Comparison with V.C. systems, Applications, Problems.

Unit V **Psychrometry of Air & Air Conditioning Processes:** Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity,

Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process, Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

Unit VI **Air- Conditioning Load Calculations:** Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

Unit VII **Air Conditioning Systems with Controls & Accessories:** Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

Unit VIII **Refrigeration and Air Conditioning Equipments:** Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

Course Outcomes:

1. To apply the principles and applications of refrigeration systems
2. Analyse vapour compression refrigeration system and identify methods for performance improvement.
3. Able to understand working principles of air, vapour absorption, thermoelectric and steam-jet refrigeration systems.
4. Able to understand the air-conditioning processes using the principles of psychrometry.

Text Books:

1. Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India.
2. Refrigeration & Air conditioning –C.P. Arora, TMH, New Delhi.

Reference Books:

1. A course in Refrigeration & Air Conditioning – Arora & Domkundwar, Dhanpat Rai & Sons.
2. Refrigeration & Air conditioning –W.F. Stocker and J.W. Jones, TMH, New Delhi.
3. Refrigeration & Air conditioning- Manohar Prasad Wiley Estern limited, New Delhi.

Note: In the semester examination the examiner will set eight questions in all one question from each unit. The students will be required to attempt only 5 questions.

ME- 405 E OPERATIONS RESEARCH

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Pursue the study of OR to solve the problems of society and organization.
2. To be a leader for effective decision making.

Unit I **Introduction:** Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Unit II **Linear Programming (LP):** Programming definition, formulation, solution- graphical, simplex Gauss-Jordan reduction process in simplex methods, BIG-M methods computational, problems.

Unit III **Deterministic Model:** Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Unit IV **Advanced Topic Of LP:** Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

Unit V **Waiting Line Models:** Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Unit VI **Project Line Models:** Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

Unit VII **Simulation:** Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Unit VIII **Decision Theory:** Decision process, SIMON model types of decision making environment- certainty, risk, uncertainty, decision making with utilities, problems.

Course Outcomes:

1. Understand the concepts of Operations Research.
2. Study the principles of linear programming problems and for their applications.
3. Study the principles of transportation problems and assignment problems.
4. Formulate the OR models for various needs of the society and organization.
5. Solve the problems of society and organization using OR techniques.

Text Books:

1. Operation Research – TAHA, PHI, New Delhi.
2. Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.

Reference Books:

1. Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2. Quantitative Techniques- Vohra, TMH, New Delhi
3. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
4. Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
5. Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

Note: Paper setter will set eight questions, at least one from each unit. Students are required to answer five questions.

ME 415 E MECHANICAL VIBRATIONS

L	T	P	Credit
3	1	----	3.5

Course Objectives:

To introduce the fundamentals of free and forced mechanical vibrations for single, two and multi degree of freedom systems.

Unit I **Fundamentals:** Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion.

Unit II **Free and Damped Vibrations :** Single Degree of Freedom system, D'Alemberts Principal, Energy Methods, Rayleighs Method, Application of these Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

Unit III **Harmonically Excited Vibrations :** Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent, Viscous Camping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

Unit IV **Transient Vibrations:** Impulse Excitation, Arbitrary Excitation, Response to Step Excitions, Base Excitation Solution by Laplace Transforms, Response Spectrum, Runge-Kutta Method.

Unit V **Two Degrees of Freedom Systems :** Introduction to Multi-Degree of Freedom Systems, Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper.

Unit VI **Multi degrees of Freedom Systems and Numerical Methods:** Introduction, Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Dunkerley's Equation, Method of Matrix Iteration, The Holzer Type Problem, Geared and Branched Systems, Beams.

Unit VII **Normal Mode Vibration of Continuous System:** Vibrating String, Longitudinal Vibrations of Rod, Torsional Vibrations of Rod, and Lateral Vibrations of Beam.

Course Outcomes:

1. Understand the principles of the single degree of freedom systems of all types with applications.
2. Understand the fundamentals of two degree of freedom systems and their applications.
3. Understand the multi degree of freedom systems of all types with their exact and approximate solutions along with their applications.

Text Books:

1. Theory of Vibrations with Applications W.T. Thomson, Prentice Hall of India.
2. Mechanical Vibration: G.K. Grover and S.P. Nigam, Nem Chand and Sons.

Reference Books:

1. Theory and Practice of Mechanical Vibrations J.S. Rao and K. Gupta, Wiley Eastern Ltd.
2. Mechanical Vibrations S.S. Rao, Addison – Wesely Publishing Company.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit & students will be required to attempt only 5 questions

ME 415 E Department Elective – I*

L	T	P	Credit
3	1	----	3.5

Seventh Semester

CODE	Subject	L	T	P	CREDIT
ME 451 E	Finite Element Methods	3	1	-	3.5
ME 453 E	Energy Management Principles	3	1	-	3.5
ME 455 E	Engineering Design	3	1	-	3.5
ME 457 E	Computer Integrated Manufacturing	3	1	-	3.5
ME 459 E	Manufacturing Management	3	1	-	3.5
ME 461 E	Reliability Engineering	3	1	-	3.5
ME 463 E	Solar Energy Engineering	3	1	-	3.5
ME 465 E	Design of Heat Exchangers	3	1	-	3.5
ME 467 E	Value Engineering	3	1	-	3.5

ME- 451 E FINITE ELEMENT METHODS*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Unit I **Fundamental Concepts:** Introduction; Historical Background, Stresses and Equilibrium, Boundary Conditions, Strain-displacement, Relations, Stress- strain Relations, Temperature Effects, Potential Energy and Equilibrium; The Rayleigh-Ritz Method, Galerkin's method. Saint Venant's Principle, Matrix Algebra, Gaussian Elimination.

Unit II **One-Dimensional Problems:** Introduction; Finite Element Modeling, Coordinates and a Shape Functions, The Potential Energy Approach; The Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector. Properties of Stiffness Matrix, The Finite Element Equations; Treatment of Boundary Conditions, Quadratic Shape Functions; Temperature effects.

Unit III **Two-Dimensional Problems using Constant Strain Triangles:** Introduction, Finite Element Modeling, Constant Strain Triangle, Problem Modeling and Boundary conditions; Axis Symmetric Solids subjected to Axis Symmetric Loading:- Introduction, Axis Symmetric Formulation, Finite Element Modeling; Triangular Element, Problem Modeling and Boundary conditions.

Unit IV **Two Dimensional Isoparametric Elements and Numerical Integration:** Introduction, The Four- Node quadrilateral, Numerical Integration Stress Calculations, High – Order Element; Nine-Node quadrilateral, Eight-Node Quadrilateral, Six-Node triangle, Comment on Midside Node; Problems.

Unit V **Beams & Frames:** Introduction, Finite Element formulation, Load Vector, Boundary considerations, Shear Force and Bending Moment, Beams on Elastic supports, Plane Frames, Simple Numerical.

Unit VI **Three-Dimensional Problems in Stress Analysis:** Introduction, Finite Element Formulation, Stress Calculations, Mesh Preparation, Hexahedral Elements and Higher-order Elements, Problem Modeling.

Unit VII **Scalar Field Problems:** Introduction, Steady-state Heat Transfer,: Introduction One-Dimensional Heat Conduction, Heat transfer in thin Fins, Two-dimensional steady-state Heat conduction, Potential Flow, Seepage, Fluid flow in Ducts.

Unit VIII **Dynamic Considerations:** Introduction, Formulation, Element Mass Matrices: Evaluation of Eigen values and Eigenvectors, Interfacing with previous Finite Element Programs and a program for determining critical speeds of Shafts.

Text Books:

1. Introduction to Finite Elements in Engineering Analysis by Tirupathi R. Chandruipatala and Ashok R. Belagundu. Prentice Hall.
2. The Finite Element Method in Engineering by S.S.Rao, Peragamon Press, Oxford.

Reference Books:

1. Finite Element Procedures, by Klaus JurgenBathi, Prentice Hall.
2. Concepts and Applications of Finite Element Analysis, by Cook, Malkus and Plesha, John Wiley.
3. The Finite Element Method by Zienkiewicz published by Mc Graw Hill.
4. An Introduction to Finite Element Method by J.N. Reddy published by Mc Graw Hill.

Note: In the Semester examination, the examiner will set eight questions. At least one question from each unit. The students will be required to attempt only 5 questions.

ME– 453 E ENERGY MANAGEMENT PRINCIPLES(Elective – I)

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Basic need and importance of energy management.
2. Understand the principles associated with effective energy management and to apply these principles in the day-to-day life.
3. Energy management in heating and cooling systems, electric and lighting systems, thermal systems.
4. Gain exposure to energy auditing, to identify energy conservation opportunities in various industrial processes.
5. Economics for energy management.
6. Application of computer in energy management.

UNIT I **Planning for Energy Management:** Initiation phase, Audit and analysis phase; Implementation phase; General methodology for building and site energy audit; Site survey, Methodology; Site survey-Electrical system, Steam & water systems; Building survey methodology; Basic energy audit instrumentation; Measurements for building surveys.

UNIT II **Management of Heating and Cooling General Principles:** The requirements for human comfort; Description of typical systems-dual duct HVAC system, Multi zone HVAC systems, Variable an volume system, Terminal reheat system, Evaporative HVAC systems; Modeling of heating and cooling loads in buildings; Problems.

UNIT III **Electrical load and Lighting Management:** General principles; Illumination and human comfort; Basic principles of lighting system; Typical illumination system and equipment; Fundamentals of single phase and 3-phase A.C. circuits; Energy management opportunities for lighting systems, Motors and electrical heat; Electrical load analysis and their parameters; Peak, demand control; Problems.

UNIT IV **Management of Process Energy :** General Principles; Process heat; Combustion; Energy saving in condensate return, Steam generation & distribution, auto-motive fuel control, hot water and water pumping, direct & indirect fired furnaces over; Process electricity; Other process energy forms – compressed air & manufacturing processes; Problems.

UNIT V **Economics of Efficient Energy Use:** General Consideration Life Cycle Costing, Break Even Analysis, Cost of Money, Benefit / Cost Analysis, Pay Back Period Analysis, Present Worth Analysis, Equivalent Annual Cost Analysis, Capital Cost Analysis, Perspective Rate of Return. Problems.

UNIT VI **Integrated Building System:**General Principles; Environmental conformation; Passive design consideration; Building envelope design consideration; Integration of building system; Energy storage; Problems.

UNIT VII **Use of Computer for Energy Management :** Energy management; Energy management principle involving computers, Basics of computer use; Analysis – Engineering & Economic calculations, Simulation, Forecast, CAD/CAM; Controls – Microprocessor &

minicomputers, Building cycling & control, Peak demand limiting & control; Industrial Power management; Problems.

Course Outcomes:

1. Understand the objectives, scope, benefits of energy management.
2. Knowledge of various tools and components energy auditing.
3. Evaluate cooling and heating load in various thermal and energy systems.
4. Economics analysis for energy systems.
5. Computer programming for Energy Management.

Text Books:

1. Energy management Principles by Craig B. Smith, Published by Pergamon Press.
2. Energy systems and developments – Jyoti Parikh, Oxford University Press.

Reference Books:

1. Energy – resources, demand and conservation with reference to India – Chaman Kashkari, TMH.
2. Integrated renewable energy for rural development– Proc. of natural solar energy convention, Calcutta.

NOTE:In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 455 E ENGINEERING DESIGN *(Elective - I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic overview of design philosophy.
2. To provide to the students an understanding of mechanical design.
3. To impart knowledge of ergonomics.
4. To study improvement in design factors with design analysis.
5. To impart in depth knowledge of Modelling, Analogy & Simulation.
6. To expose the students to the selection of materials while considering different aspects of design.
7. To impart knowledge to the students about Processing and Design.
8. To impart knowledge about costing.

Unit I **Design Philosophy :** Definition of Design, Difference between Science, Engineering and Technology, Morphology of Design, Definition of Product Design, Design by Evolution, Design by Innovation, Invention and Brainstorming.

Unit II **Considerations Dictating Mechanical Design:** Basic Considerations- Convenience of Use, Maintenance Cost and Appearance; Operational Considerations: Operational Requirements - Strength (Volume & Surface), Rigidity (proper and contact), Vibration, Thermal Resistance etc.; Design for Strength, Design for Rigidity. Design for Stability (buckling) with Illustrations; Functional Requirements – Conformiting (among various components), Concept of Synthesis and Assembly, Role of Fits, Tolerance and Process Capability.

Unit III **Human Engineering:** Human factors in Engineering Design, Man-machine Systems, Human Physical Activities and Human Control of Systems, Visual Displays of Static and Dynamic Information, Work Environment – Illumination, Atmospheric Conditions, Noise etc.

Unit IV **Ingenuity in Design:** Tips to increase Strength and Rigidity of m/c components, Concept of Standardization. Simplification (Preferred numbers or Renard series). Concept of Slim Design – Use of Reinforcement, Ribs, Corrugations, Laminations etc. – their Design Analysis; Designation of different types of Fits, Design of Interference Fit Joints, Cumulative Fatigue Failure & Minor's Equation.

Unit V **Modeling, Analogy & Simulation:** Types of Models and their uses with emphasis on Mathematical Modeling, Importance of Analogy in Design, Electrical – Mechanical Analogy, Membrane Analogy. Similitude and Scale Models.

Unit VI **Material Selection:** Spectrum of material properties: Performance Characteristics of materials, Evaluation Methods for material selection – Cost vs Performance Relations, Weighted- property Index, Value Analysis – Illustrations.

Unit VII **Interactions of Materials, Processing and Design :** Role of processing in design, Economics of Manufacturing, Design for Casting, Design for Machining, Design for Welding, Design for Powder Metallurgy, Design for Assembly.

Unit VIII **Cost Analysis:** Objectives, Costs Classification, Cost Estimate Methods, Labour Costs, Product Pricing.

Course Outcomes:

1. Understand design philosophy.
2. Understand the importance of ergonomics.
3. Understand advancements & improvement in design factors with design analysis.
4. Understand Modelling, Analogy & Simulation.
5. Understand the selection of materials while considering different aspects of design.
6. Understand the concept of costing and it's need.

Text Books:

1. Product Design and Manufacturing – A.Kale& R.C. Gupta, P H I, New Delhi.
2. Engineering Design–A material & Processing Approach – George Dietor, McGraw Hill Reference.

Books :

1. Machine Elements - C.B. Rovoloky et.al., MIR Punleshan, Moscow.
2. Mechanical Engg. Design – Joseph Shigley Published by MGH.
3. Engineering Design Process: Yousef Haik, Books/Cole 2003.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 457 E COMPUTER INTEGRATED MANUFACTURING*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Learn the basics of the computer numerical control (CNC) machines.
2. To understand the robot configurations and its mechanical parts.
3. To understand flexible manufacturing system (FMS) technology and its applications.
4. Learn the overall use of computers in various components of computer integrated manufacturing (CIM).

Unit I **Introduction :** CAD/CAM Definition, Computer Technology-central processing unit (CPU), types of memory, input/output, the binary number system, computer programming languages. Automation- Types of automation, CIM, reasons for automating, automation strategies.

Unit II **Conventional Numerical Control:** Basic components of NC system, the NC procedure, NC coordinate systems, NC motion control system, applications of numerical control, advantages and disadvantages of NC, computer controls in NC, problems with conventional NC, NC controller technology, computer numerical control, functions of CNC, advantages of CNC, Direct numerical control, components of a DNC system, functions of DNC, advantages of DNC.

Unit III **NC Part Programming:** Introduction, the punched tape in NC, tape coding and format, NC words, manual part programming, computer assisted part programming, the part programmer's job, the computer's job, NC part programming languages. The APT language: Geometry, statements, motion statements, post processor statements, auxiliary statements.

Unit IV **Robotics Technology :** Joints and links, common robot configurations, work volume, drive systems, types of robot control, accuracy and repeatability, end effectors, sensors in robotics, applications of robots.

Unit V **Automated Material Handling & FMS:** The material handling function, types of material handling equipment, conveyor systems, types of conveyors, automated guided vehicle systems, applications. FMS-Components, types of systems, applying FMS technology, FMS workstation, planning.

Unit VI **Computer Aided Quality Control:** Introduction, terminology in Quality Control, the computer in QC, contact and non-contact inspection methods-optical and non-optical, and computer aided testing.

Unit VII **Computer Integrated Manufacturing Systems:** Introduction, types, machine tools and related equipments, material handling systems, computer control systems, function of the computer in a CIMS, CIMS benefits.

Course Outcomes:

1. Develop programs for CNC machines using manual part programming and programming languages.
2. Create application specific configurations of robots.
3. Apply the FMS technology to create automatic manufacturing systems.
4. Use the computers in inspection and testing of the final manufactured product.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
2. CAD/CAM – Groover M.P, Zimmers E.W, Prentice Hall of India.

Reference Books:

1. Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley

Note: The paper setter will set 8 questions taking at least one question from each unit.Students will be required to answer only five.

ME 459 E MANUFACTURING MANAGEMENT*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To understand Manufacturing Systems Designs.
2. To understand Manufacturing Systems Economics.
3. To understand New Product Development.
4. To understand Manufacturing Planning & Control Systems.

Unit I **Manufacturing Systems Designs:** Definition, Systems, Subsystems, Systems Approach Fundamentals, Systems Approach for designing, Manufacturing Systems, Systematic Layout Planning (SLP),Computerized Plant Layout- CRAFT, ALDEP, CORELAP, Assembly Line balancing, Problems and solutions of assembly lines, Group Technology & Cellular Systems, Classification & Grouping, overview of FMS. Strategic consideration for comparison of various systems.

Unit II **Manufacturing Systems Economics:** Concept of time value of money, Preparation of time profile of project, Single payment, Equal Series payment, various machine and project selection & evaluation techniques: Payback period, Present worth, Equivalent annual cost, Cost- benefit ratio, Evaluation for both equal & unequal life. Depreciation concept various methods-straight line, declining balance, Sum of the digits, Sinking fund.

Unit III **New Product Development (NPD):** Product Development, Customer Need, Strategies for New Product Development, Product life cycle, Product status. Corporate Design Strategies, Japanese Approach to NPD. PUGH total Design approach, PAHL & BEITZ Approach, Project Approach, Cross functional Integration –Design, manufacturing, Marketing, Concurrent Engineering, Modular Design, Standardization Value Engineering & Analysis.

Unit IV **Manufacturing Planning & Control Systems:** Overview of Aggregate Planning Models, Linear Decision Rules, Management Coefficient, Direct Search Methods, Master Production Schedule, Modular Bill and Materials, Capacity planning & control, language, medium range, short range capacity planning, Just- in Time (JIT), Manufacturing – Philosophy, Elements, KANBAK, effects on layout, workers & vendors, optimized production technology (OPT).

Unit V **Forecasting Methods:** Forecasting Framework, Forecasting cost and accuracy, Forecasting Uses and Methods – Delphi, Exponential Smoothing, Forecasting Errors – MAD, Regression Methods _ Linear Model for single & multiple variables, Brief idea of computerized forecasting systems.

Unit VI **Material Requirements Planning (MRP):** Definition of MRP systems. MRP versus Order point, MRP Elements, Types of MRP – MRP I & II. Structured Bill of Materials. Regenerative & Net change MRP, Operating an MRP, Integration of Production & Inventory Control.

Unit VII **Maintenance & Reliability:** Concept of preventive & breakdown maintenance, maintenance cost, optimal preventive maintenance simple replacement models- individual and group replacement, MAPI - methods, reliability definitions, failure analysis and curve, systems reliability- series parallel, redundancy, methods of improving reliability, MTBF, MTTR, Maintainability, availability, brief concept of tero-technology.

Course Outcomes:

1. Make the plant layout by computerized methods.
2. Make the cost analysis of the projects.
3. Make strategies for development of new product.
4. Make plans for optimized production technology.

Text Books:

1. Operations Management – SCHOROEDER, MGH, New York.
2. Production Operations Management – CHARY, TMH, New Delhi.

Reference Books:

1. Production Operations Management – ADAM & EBERT, PHL, New Delhi
2. Operational Management –MONKS, McGraw Hill, Int.
3. Production & Operations Management – I. Hill, Prentice Hall, Int.
4. Production Planning & Inventory Control – NARASIMHAM etal, PHL, New Delhi
5. Production & Operation Management- Panneerselvam, PHI, New Delhi
6. Managing for total Quality-LOGOTHETIS, PHI, New Delhi
7. Concept of Reliability Engineering –L.S. Srinath, Affiliated East West.
8. Revolutionizing Product Development – WHEELWRIGHT & CLARK, Free Press.
9. Management in Engineering – FREEMAN-BALL & BALKWILL, PHI, New Delhi.
10. Production & Operations Management – MARTINICH, John Wiely SE, New Delhi.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 461 E RELIABILITY ENGINEERING*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Impart the knowledge on principles of reliability, failure rate and its relation to reliability, probability distribution of the time to failure, exponential and Weibull distributions, reliability of systems, series and parallel systems, stand by redundancy, systems mean time to failure, mean residual life, reliability in design.
2. It also imparts the knowledge of failure mode effect analysis, failure tree analysis, reliability testing and analysis, and warranty problems.

Unit I **Reliability:** Definition; Probability Concept; Addition of Probabilities; Complimentary Events; Kolmogorov Axioms.

Unit II **Failure Data Analysis:** Introduction, Mean Failure Rate, Mean Time to Failure (MTTF), Mean Time between Failures (MTBF), Graphical Plots, MTTF in terms of Failure Density, MTTF in Integral Form.

Unit III **Hazard Models:** Introduction, Constant Hazard; Linearly Increasing Hazard, The Weibull Model, Density Function and Distribution Function, Reliability Analysis, Important Distributions and their Choice, Standard Deviation and Variance.

Unit IV **Conditional Probability:** Introduction, Multiplication Rule, Independent Events, Vernn Diagram, Hazard Rate as conditional probability, Bayes Theorem.

Unit V **System Reliability:** Series. Parallel and Mixed Configurations, Complex Systems, Logic Diagrams, Markov Models.

Unit VI **Reliability Improvement & Repairable Systems:** Redundancy, Element, Unit and standby Redundancy, Optimization; Reliability – cost trade- off, Introduction to Repairable Systems, Instantaneous Repair Rate, MTTR, Reliability and Availability Functions, Important Applications.

Unit VII **Fault-Tree Analysis and Other Techniques:** Fault-tree Construction, Calculation of Reliability, Tie- set and Minimal Tie-set.

Unit VIII **Maintainability and Availability:** Introduction, Maintenance Planning, Reliability and Maintainability trade – off.

Course Outcomes:

1. Learn the basics elements of hydroelectric power plant and their layout.
2. Understand the concepts of reliability, availability and maintainability.
3. Develop hazard-rate models to know the behavior of components.
4. Build system reliability models for different configurations.
5. Asses reliability of components and systems using field and test data.
6. Implement strategies for improving reliability of repairable and non-repairable systems.

Text Books:

1. Reliability Engineering, L.S. Srinath, Affiliated East-West Press, New Delhi.

2. Reliability Engineering, A.K.Govil, Tata Mc-Graw Hill, New Delhi.

Reference Books:

1. Reliability Engineering, L.Balagurusamy, Tata Mc-Graw Hill, New Delhi, 1984.
2. Reliability Based Design, S. Rao, Mc-Graw Hill, 1992.
3. Reliability in Engineering Design, K.C. Kapur and L.R. Lamberson, Wiley Publications.
4. Reliability Engineering, D.J. Smith, 1972, E.W. Publications.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 463 E SOLAR ENERGY ENGINEERING*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Basics of solar energy, how to determine solar intensity, and how to estimate daily and annual solar energy potential at each location.
2. To introduce the basic concepts and novel technologies in solar thermal systems
3. To develop skills to design, model, analyze and evaluate solar thermal systems.
4. Be able to understanding of principles and technologies for solar thermal energy collection, conversion and utilization.
5. Provide students for practical training in the design of different solar thermal systems, such as water heating and control, solar collection, solar energy storage and system design.

Unit I **Solar Radiation:** Introduction, solar system – sun, earth and earth-sun angles, time, derived solar angles, estimation of solar radiation (direct and diffuse), measurement systems – phyrheliometers and other devices.

Unit II **Effect of Solar radiation upon structures:** Steady state heat transmission, solar radiation properties of surfaces, shading of surfaces, periodic heat transfer through walls and roofs.

Unit III **Solar Collectors:** Flat plate and concentrating – comparative study, design and materials, efficiency, selective coatings, heliostats.

Unit IV **Heating Applications of Solar Energy:** Air and Water heating systems, thermal storages, solar bonds, solar pumps, solar lighting systems, solar cookers, solar drying of grains.

Unit V **Cooling Applications of Solar Systems:** Continuous and intermittent vapour absorption systems for cooling applications, absorbent – refrigerant combination, passive cooling systems.

Unit VI **Solar Electric Conversion Systems:** Photovoltaics, solar cells, satellite solar power systems.

Unit VII **Effects on Environment:** economic scenario, ozone layer depletion, green house effect, global warming, Remedial measures by international bodies.

Course Outcomes:

1. Learn Solar Radiation Spectrum and the Greenhouse effect.
2. Solar energy conversion: Thermal, Photovoltaic, Concentrating Solar, and Thermo-photovoltaics.
3. Understanding of solar heating systems, liquid based solar heating systems for buildings.
4. Identify, formulate and solve simple to complex problems of solar thermal energy conversion and storage.
5. Identify and understand solar thermal systems' components and their function.

Text Books:

1. Solar Energy – S P Sukhatme, Tata McGraw Hill
2. Solar Energy Process – Duffie and Bechman, John Wiley

Reference Books:

1. Applied Solar Energy – Maniel and Maniel, Addison Wiley
2. Solar Energy: Fundamentals and Applications – R P Garg and Jai Prakash, TMH.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 465 E DESIGN OF HEAT EXCHANGERS*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To know the basic design principles of heat exchangers
2. To know about the working of shell and tube type, compact, and plate heat exchangers.
3. To know about the condensers, evaporators, and regenerators.

Unit I **Classification of Heat exchangers:** Introduction ; Recuperation and regeneration, Transfer processors, Geometry of construction–tubular heat exchangers, plate heat exchangers, extended surface heat exchanges, Heat transfer mechanisms, Flow arrangements, Selection of heat exchangers.

Unit II **Basic Design Methods of Heat Exchanges:** Introduction, Arrangement of flow path in heat exchangers , Basic equations in design, Overall heat transfer coefficient , Log mean temperature difference method for heat exchanger analysis , The $\in$-NTU method for heat exchanger analysis, Heat exchanger design calculation, Variable overall heat transfer coefficient , Heat exchanger design methodology.

Unit III **Design Correlations for Condensers and Evaporators:** Introduction, Condensation, Film condensation on a single horizontal tube-laminar film condensation, forced convection, Film condensation in tube bundles-effect of condensate inundation, effect of vapor shear, combined effects of inundation and vapor shear, Condensation inside tubes-condensation in vertical tubes, Flow boiling-sub-cooled boiling, flow pattern, flow boiling correlations.

Unit IV **Shell and Tube Heat Exchangers:**Introduction, Basic components-shell types, tube bundle types, tubes and tube passes, tube layout, baffle type and geometry, allocation of streams, Basic design procedure of a heat exchanger-preliminary estimation of unit size, rating of preliminary design, Shell-slide heat transfer and pressure drop-shell-side heat transfer coefficient, shell-side pressure drop, tube-side pressure drop, Bell-Delaware method.

UnitV **Compact Heat Exchangers:**Introduction, Plate-fin heat exchangers, tube-fin heat exchangers, Heat transfer and pressure drop-heat transfer, pressure drop for finned-tube exchangers, pressure drop for plate-fin exchangers.

Unit VI **Gasketed Plate Heat Exchangers:** Introduction, Mechanical features-plate pack and frame, plate types, Operational characteristics-main advantages, performance limits, Passes and flow arrangements, Application-corrosion, maintenance, Heat transfer and pressure drop calculations-heat transfer area, mean flow channel gap, channel equivalent diameter, heat transfer coefficient, channel pressure drop, port pressure drop, overall heat transfer coefficient, heat transfer surface area, performance analysis, Thermal performance.

Unit VII **Condensers and Evaporators:** Introduction, Shell-and-tube condensers-horizontal shell-side condensers, vertical shell-side condensers, vertical tube-side condensers, horizontal in-tube condensers, Steam turbine exhaust condensers, Plate condensers, Air-cooled condensers, Direct contact condensers, Thermal design of shell-and-tube condensers, Design and operational considerations, Condensers for refrigeration and air-

conditioning-water cooled condensers, air-cooled condensers, evaporative condensers, Evaporative for refrigeration and air-conditioning-water-cooling evaporators (chillers), air-cooling evaporators (air coolers), Thermal analysis-shah correlation, Kandlikar correlation, Gungor and Winterton correlation, Standards for evaporators and condensers.

Unit VIII **Regenerators:** Classifications-fixed bed regenerators, rotary regenerators, basic design method, Influence of fluid bypass carry-over, Pressure drop evaluation, The rating problem, surface geometrical properties, Pressure drop, Sizing problem.

Course Outcome:

1. To understand the basic design aspects, working and operation principle of shell and tube type, compact, plate type heat exchangers.

Text Books:

1. Heat Exchangers, SadikKakac, HongtanHiu , CRC Press.
2. Principles of Heat Transfer, F.Krieth& M.S. Bohn, Asian Books Pvt. Ltd., Delhi.

Reference Books:

1. Heat exchangers, Design and Theory Source Book, N.H. Afgan and Schliinder MGH.
2. Compact Heat Exchanger, W.M. Kays& A.L. London, MGH.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 467 E VALUE ENGINEERING*(Elective – I)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the importance of value engineering and its advantages.
2. To impart knowledge of problem recognition, and its role in productivity.
3. To expose the student to know the importance of value engineering in an organization.
4. To impart knowledge to the students about the different values and analysis of functions of value engineering.
5. To impart the knowledge to the student about different value engineering techniques.

PART- A

UNIT – I **Introduction:**

Value Engineering concepts, Advantages, Applications, Problem recognition, and role in productivity criteria for comparison, element of choice.

UNIT – II **Organization:**

Level of VE in the organization, Size and skill of VE staff, small plant VE activity.Unique and quantitative evaluation of ideas.

PART- B

UNIT – III **Analysis of Function:**

Anatomy of the function, Use esteem and exchange values, Basic vs secondary vs. unnecessary functions.

UNIT – IV **Value Engineering Techniques:**

Selecting products and operation for VE action, VE programmes, determining and evaluating function(s) assigning rupee equivalents, developing alternate means to required functions, decision making for optimum alternative, Use of decision matrix, Queuing theory and Monte Carlo method, make or buy, Measuring profits, Reporting results, Follow up, Use of advanced technique like FAST (Function Analysis System) Tech.

Course Outcomes:

1. Understand the concept and importance of value engineering.
2. Understand the different level, size and skill of value engineering.
3. Understand the functions of value engineering which are necessary and unnecessary.
4. Understand the various techniques used in value engineering.

Reference and Text Books:

1. Techniques of Value analysis and engineering – Miles, Pub.- McGraw Hill.
2. Value Management – Heller Pub.- Addison Wesley.
3. Value Analysis and Value – Oughson, Pub.- Pitman.

Note: In the semester examination, the examiner will set eight questions in all, taking two questions from each unit. The students will be required to attempt 5 questions in all, taking at least two questions from each Part.

ME- 407 E AUTOMOBILE ENGINEERING LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. Expose the students to various automotive engine system and fuel supply system.
2. Impart the knowledge on various components with their operation of an automobile.
3. Impart the knowledge on Automotive Emission / Pollution control systems.
4. Impart the knowledge of modelling and designing of automotive system using educational software.

List of Experiments:

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems.
   (a) Multi-cylinder : Diesel and Petrol Engines.
   (b) Engine cooling & lubricating Systems.
   (c) Engine starting Systems.
   (d) Contact Point & Electronic Ignition Systems.

2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:
   (a) Carburetors
   (b) Diesel Fuel Injection Systems
   (c) Gasoline Fuel Injection Systems.

3. . To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches.
   (a) Coil-Spring Clutch
   (b) Diaphragm – Spring Clutch.
   (c) Double Disk Clutch.

4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems.
   (a) Synchromesh – Four speed Range.
   (b) Transaxle with Dual Speed Range.
   (c) Four Wheel Drive and Transfer Case.
   (d) Steering Column and Floor – Shift levers.

5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials.
   (a) Rear Wheel Drive Line.
   (b) Front Wheel Drive Line.
   (c) Differentials, Drive Axles and Four Wheel Drive Line.

6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems.

(a) Front Suspension System.
(b) Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems.
   (a) Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering.
   (b) Power steering Systems, e.g. Rack and Pinion Power Steering System.
   (c) Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.

8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres& wheels.
   (a) Various Types of Bias & Radial Tyres.
   (b) Various Types of wheels.

9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
   (a) Hydraulic & Pneumatic Brake systems.
   (b) Drum Brake System.
   (c) Disk Brake System.
   (d) Antilock Brake System.
   (e) System Packing & Other Brakes.

10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)

12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver or other software.

Course Outcomes:

1. Understand the automotive engine system and fuel supply system.
2. Understand the construction, principle & working of various automobile components.
3. Understand the Automotive Emission / Pollution control systems.
4. Understand the designing and modeling of automotive system.

NOTE:

1. ***At least ten experiments are to be performed in the Semester.***
2. ***At least seven experiments should be performed from the above list. Remaining three experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus.***

ME- 409 E REFRIGERATION & AIR CONDITIONING LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. To teach students how to apply the knowledge of refrigeration and air conditioning principles to conduct experiments.
2. To help the students measure COP of different types of refrigeration systems.

List of Experiments:

1. To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-H and T-S diagrams.
2. To Study the Mechanical heat pump and find its C.O.P.
3. To study the Air and Water heat pump and find its C.O.P.
4. To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.
5. To study the various controls used in Refrigerating & Air Conditioning systems.
6. To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
7. To study the humidification, heating, cooling and dehumidification processes and plot them on Psychrometric charts.
8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts on different inlet conditions.
9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.
10. To study the chilling plant and its working cycle.

Course Outcomes:

1. Conduct the experiments on refrigeration and air conditioning
2. Analyze the performance of VCR systems and vapour absorption system.
3. Know about the components of the Refrigeration and air-conditioning systems.

Note:

1. ***At least ten experiments are to be performed in the semester.***
2. ***At least seven experiments should be performed form the above list. Remaining three experiments may either be performed from the above list or as designed & set by the concerned institute as per the scope of the syllabus.***

ME- 411 E PROJECT (Starts)

L	T	P	Credit
---	---	4	2.0

Course Objectives:

1. Enable the students to identify a problem in mechanical engineering field using literature survey/ industry survey.
2. Generate innovative ideas for the solution of identified problems or improvement in the existing system of mechanical engineering field.

Project involving design/ fabrication/ testing computer simulation/ case studies etc. which is commenced in VIIth Semester, will be completed in VIIIth Semester and will be evaluated through a panel of examiners consisting of HOD of the concerned department, project coordinator and one external examiner to be appointed by the University.

The student will be required to submit three copies of his/her project report to the office of the concerned department for record (one copy each for the deptt. Office, participating teacher and college library).

Course Outcomes:

1. Analyze and identify the problems in the mechanical systems.
2. Select and apply proper modern tools.
3. Find solution for problems.
4. Make use of the benefits of team work.

ME – 413 E PRACTICAL TRAINING – II

L	T	P	Credit
---	---	3	1.5

At the end of sixth semester each student would undergo six weeks Practical Training in an Industry/ Professional / Organization/ Research Laboratory with the prior approval of the Director-Principal/ Principal of the concerned college and submit a written typed report along with a certificate from the organization. The report will be a evaluated during VII Semester by a Board of Examiners to be appointed by the Director-Principal/ Principal of the concerned college who will award one of the following grades:

Excellent	:	A
Good	:	B
Satisfactory	:	C
Not satisfactory	:	F

A student who has been awarded 'F' grade will be required to repeat the practical training.

ME- 402 E COMPUTER AIDED DESIGN & MANUFACTURING

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. To expose the students to the application of computers in design and manufacturing process. And to provide the basic overview to the students for the different type of geometric transformation used during CAD geometry generation & display and their evaluation.
2. To impart knowledge of various mathematical representations of the curves & surfaces used in the geometric construction.
3. To study various methodologies used for geometric construction such as sweep, surface models and solid models.
4. To impart in depth knowledge for part programming in terms of the various steps needed to be taken for completing a successful CNC part programme.
5. To expose the students to the need for group technology and FMS

Unit – I **Introduction:** Introduction to CAD/CAM, Historical developments, Industrial look at CAD/CAM, Introduction to CIM; Basics of geometric and solid modeling, explicit, implicit, intrinsic and parametric equations and coordinate systems.

Unit – II **Transformations:** Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, orthographic and perspective projections, reconstruction of 3-D objects.

Unit – III **Curves:** Algebraic and geometric forms, tangents and normal, blending functions reparametrization, straight lines, conics, cubic splines, Bezier curves and B-spline curves.

Unit – IV **Surfaces:** Algebraic and geometric forms, tangents and normal, blending functions, reparametrization, sixteen point form, four curve form, plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, bezier surface, B-spline surface.

Unit – V **Solids:** Solid models and representation scheme, boundary representation, constructive solid geometry, sweep representation, cell decomposition, spatial occupancy enumeration.

Unit – VI **Automation and Numerical Control:**Introduction, fixed, programmable and flexible automation, types of NC systems, MCU and other components, NC manual part programming, coordinate systems, G & M codes, Part program for simple parts, computer assisted part programming.

Unit – VII **Group Technology:** Part families, part classification and coding, production flow analysis, Machine cell design, Advantages of GT

Unit – VIII **Flexible Manufacturing Systems & Computer aided process planning:** Introduction, FMS components, types of FMS, FMS layouts, planning for FMS, advantages and applications Coventional process planning, types of CAPP, Steps in variant process planning, planning for CAPP.

Course Outcomes:

1. Understand the application of computers in design and manufacturing process and different type of geometric transformation used during CAD geometry generation & display and their evaluation.
2. Understand the mathematical representations of the curves & surfaces used in the geometric construction.
3. Understand various methodologies used for geometric construction such as sweep, surface models and solid models.
4. Understand the part programming in terms of the various steps needed to be taken for completing a successful CNC part programme.
5. Understand the need for group technology and the concept of FMS

Text and Reference Books:

1. CAD/ CAMby Groover and Zimmer, Prantice Hall.
2. CAD/ CAM Theory and Practice by Zeid, McGraw Hill
3. Numerical Control and Computer Aided Manufacturing by Kundra, Rao&Tiwari, TMH.
4. CAD/CAM (Principles, Practice & Manufacturing Management) by ChirsMc Mohan & Jimmie Browne, Published by Addison- Wesley.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit. The students will be required to attempt only 5 questions

ME- 404 E POWER PLANT ENGINEERING

L	T	P	Credit
3	1	---	3.5

Course Objectives:

1. Know the functions of various equipment /parts of different thermal systems.
2. Understand the thermal power plant systems.
3. Familiarize with operation of nuclear, hydroelectric, and gas turbine power Plants.
4. Familiarize with non-conventional, renewable energy sources, and direct energy conversion systems, with power plant economics.

Unit I **Introduction**: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Unit II **Hydro Electric Power Plants:** Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

Unit III **Steam Power Plants:** Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Unit IV **Combined Cycles:** Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

Unit V **Nuclear Power Plants:** Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

Unit VI **Power Plant Economics:**Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-out put curves, efficiency, heat rate, economic load sharing, Problems.

Unit VII **Non-Conventional Power Generation:** Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

Unit VIII **Direct Energy Conversion Systems:** Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

Course Outcomes:

1. To gain the basic knowledge regarding the various power plant systems
2. To understand the various methods of tariffs of energy issue.

Text and Reference Books:

1. Power station Engineering and Economy by Bernhardt G.A. skrotzki and William A. Vopat – Tata McGraw Hill Publishing Campany Ltd., New Delhi
2. Power Plant Engineering: P.K. Nag Tata McGraw Hill second Edition 2001.
3. Power Plant Engg. : M.M. El-Wakil McGraw Hill 1985.

Note: In the semester examination, the examiner will set eight questions in all, at least one question from each unit. The students will be required to attempt only 5 questions

Department Elective – II

L	T	P	Credit
3	1	----	3.5

Eighth Semester

CODE	Subject	L	T	P	CREDIT
ME 452 E	Optimization Methods for Engineering Systems	3	1	-	3.5
ME 454 E	Machine Tool Design	3	1	-	3.5
ME 456 E	Total Quality Control	3	1	-	3.5
ME 458 E	Pumps, Fans, Blowers & Compressors	3	1	-	3.5
ME 460 E	Design of Air-conditioning Systems	3	1	-	3.5
ME 462 E	Computer Aided Vehicle Design	3	1	-	3.5
ME 464 E	Mechatronics	3	1	-	3.5
ME 466 E	Flexible Manufacturing System	3	1	-	3.5
ME 468 E	Non-conventional Energy	3	1	-	3.5

ME- 452 E OPTIMIZATION METHODS FOR ENGINEERING SYSTEMS*(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Pursue the study of optimization methods to solve the problems of society and organization.
2. To be a leader for effective decision making.

Unit I **Introduction:** Engineering Applications; Statement of the Optimal Problem: Classification; Optimization Techniques.

Unit II **Classical Methods:** Single Variable Optimization; Multivariable Optimization without any Constraints with Equality and Inequality Constraints.

Unit III **One-Dimensional Minimization Methods:**Uni-model Function; Elimination Methods – Dichotomous Search, Fibonacce and Golden Section Methods; Interpolation Methods – Quadratic and Cubic Interpolation Methods.

Unit IV **Unconstrained Minimization Methods:**Univariate, Conjugate Directions, Gradient and Variable Metric Methods.

Unit V **Constrained Minimization Methods:** Characteristics of a constrained problem; Direct Methods of feasible directions; Indirect Methods of interior and exterior penalty functions.

Unit VI **Geometric Programming:** Formulation and Solutions of Unconstrained and Constrained geometric programming problems.

Unit VII **Dynamic Programming:** Concept of Sub-optimization and the principle of optimality; Calculus, Tabular and Computational Methods in Dynamic Programming; An Introduction to Continuous Dynamic Programming.

Unit VIII **Integer Programming:**Gomory's Cutting Plane Method for Integer Linear Programming; Formulation & Solution of Integer Polynomial and Non-linear problems.

Course Outcomes:

1. Understand the concepts of different optimization techniques.
2. Formulate the operation research models for various needs of the society and organization.
3. Solve the problems of society and organization using optimization techniques.

Text Books:

1. Optimization (Theory & Applications) – S.S. Rao, Wiley Eastern Ltd., New Delhi.
2. Optimization Concepts and Applications in Engineering - Ashok D.Belegundu and Tirupathi R Chandrupatla -- Pearson Education.

Reference Books:

1. Optimization: Theory and Practice, C.S.G. Beveridge and R.S. Schechter, MGH, New York.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions

ME- 454 E MACHINE TOOL DESIGN *(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Impart the knowledge on kinematics of different types of machine tools, selection of cutting conditions and tools, calculation of cutting force on single point and multipoint tools.
2. Imparts the knowledge on design of rotary drives, design of feed drives, control elements, design of machine tool structures and design of special purpose machines.

Unit I **Introduction:** Kinematics of Different Types of Machine Tools, Selection of Cutting Conditions and Tools, Calculation of Cutting Force on Single Point and Multipoint Tools, Hole Machining, Calculation of Power, Accuracy Requirements and Standards.

Unit II **Design of Rotary Drives:** Design of Spindle Drives, AC Motors with Stepped Drive, DC and AC Variable Speed Drive Motors Characteristics and Selection, Principle of Speed Controllers, Timings Belts and other Types of Transmission Belting, Pulleys, Closed Loop Operation of Main Drives, Rotary Indexing Drives.

Unit III **Design of Feed Drives:**Feed Drive using Feed Boxes, Axes Feed Drive of CNC Drives, DC and AC Servomotors, Types characteristics Controllers and Their Selection, Ball Screws and Friction Screws- Guide Ways, Linear Motion Systems, Design Calculations of Drives, Closed Loop Operations of Feed Drives, Linear Indexing Drives.

Unit IV **Control Elements:** Single and Multi Axis CNC Controllers, Hydraulic Control, Pneumatic Control, Limit Switches, Proximity Switches, Sequencing Control using Hard Wired and PLC Systems.

Unit-V **Design of Machine Tool Structures:** Static and Dynamic Stiffness, Dynamic Analysis of cutting process, Stability, Forced Vibration, Ergonomics and Aesthetics in Machine Tool Design.

Unit VI **Design of Spindle and Spindle Supports:** Function of Spindles, Design Requirements, Standard Spindle Noses, Design Calculations of Spindles, Bearing Selection and Mounting.

Unit VII **Finite Elements Analysis of M/C Tool Structures:** Examples of Static, Dynamic and Thermal Analysis and Optimization of Typical Machine Tool Structures Like Column, Table, Over-arm, Knee using a Finite Element Analysis Package.

Unit VIII **Design of Special Purpose Machines:** Modular Design Concepts, Standard Modules, Example of Design of a Typical SPM with CNC, Transfer Machines.

Course Outcomes:

1. Understand the kinematics of different types of machine tools, selection of cutting conditions and tools.
2. Develop the design of rotary drives, design of feed drives, design of machine tool structures and design of special purpose machines.

Text and Reference Books:

2. " Machine Tool Design" Mehta, N.K. Tata McGraw Hill,
3. Design Principal of Cutting Machine Tools :Koenigsberger f. Pergman Press Oxford.
4. "Machine Tool Design", Vol I and Vol III, Mir Publishers, Moscow, Macherkan.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 456 E TOTAL QUALITY CONTROL*(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Understand the philosophy and core values of Total Quality Management (TQM);
2. Determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;
3. Apply and evaluate best practices for the attainment of total quality.

Unit I **Quality Control:**Introduction, objectives, quality of design, quality of production, quality of conformance to design, quality of inspection, process monitoring, quality and productivity, quality cost. Advantages of Statistical Quality Control in Industry.

Unit II **Fundamentals of Statistics and Probability in Quality Control:** Events and probability, laws of probability. Statistical Distributions: Normal, Binomial and Poisson distribution, their importance in SQC. Poisson Probability as approximation to Normal Probability, use of Normal and Poisson distribution tables.

Unit III **Control Charts for Variables:**Fundamentals of process control, tools of process control, quality characteristic, Design and use of Control Charts for Variables: Trial control limits, control limits for future use, revision of control limits. Cause and effect diagram, inferences on the state of the process from control charts, Type I and Type II errors and methods to reduce them. Use of X (X bar) charts and R- charts, X (X bar) and σ- charts. Efficiency of a control chart. OC curve of a control chart. Computing average run length for X- chart.

Unit IV **Trend Control Charts:** Control Charts with Reject Limits and Modified Control Charts. Relationship between Specification Limits and Control Chart Limits, Process capability analysis and its importance in quality of conformance.

Unit V **Control Charts for Attributes:** Defects and Defectives, control charts for fraction defectives and percent fraction defectives and number of defectives. Control charts for number of defects. Comparison of control charts for variables with the charts for attributes. Computing Average run length for a p- chart.

Unit VI **Product Control and its Tools:**Fundamentals of lot-by-lot acceptance sampling by attributes: Notations, OC curve and its importance in acceptance sampling, AQL and LTPD for a sampling plan, Producer and consumer risks, Single and Double sampling plans and constructing OC curves, interpretation of the operating characteristics curve, Effect of change of sample size and acceptance number on OC curve, ATI, ASN, AOQ and AOQL concepts, economics of inspection. Item- by- item sequential sampling plans, OC curve and ASN curve for sequential sampling plan.

Unit VII **Standard Sampling Plans:** Types of Standard Sampling Plans, Difference between Acceptance-Rectification and Acceptance- Rejection Plans, single and double sampling plans based on AOQL and LTPD. Sampling plans based on Mil-Standards 105 E.

Unit VIII Motivation for quality assurance, zero defect program, quality circles, total qualitymanagement. Indian Standards on Process and Product Control. ISO-9000 Standards.

Course Outcomes:

1. Select and apply appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies;
2. Measure the cost of poor quality and process effectiveness and efficiency to track performance quality and to identify areas for improvement;
3. Understand proven methodologies to enhance management processes, such as benchmarking and business process reengineering;
4. choose a framework to evaluate the performance excellence of an organization, and determine the set of performance indicators that will align people with the objectives of the organization.

Text Books:

1. Quality control Application – By Hansen BL, Ghare PH; Prentice Hall of India.
2. Statistical Quality Control - By E.L. Grant & R.S. Levenworth; T MH.

Reference Books:

1. Quality Control – Paranthaman, D.; Tata McGraw Hill, India
2. Quality Planning and Analysis – Juran J.M. and F.M. Gryna, TMH, India
3. Total Quality Control – By Feigenbaum, A.V.; McGraw Hill International.
4. Statistical Quality Control – By Montgomery, D.C.; John Wiley & Sons (Asia)

Note:

1. ***Statistical Q.C. Tables will be supplied in examination.***
2. ***The paper setter will set Eight questions, taking at least one from each unit. Students will be required to answer only five.***

ME- 458 E PUMPS, FANS, BLOWERS AND COMPRESSORS*(Elective –II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To know design principles of centrifugal pumps and impellers
2. To know design principles of fans and blowers.
3. To know design principles of compressors both the centrifugal and axial flow.

Unit I **Pumps:** Theory of centrifugal pump impeller, vortex theory, design of impeller, volute and diffusers, specific speed and design constants.

Unit II **Design of Mixed Flow Impellers:** Geometric relationship, axial flow pumps, design, use of aerofoil data for impeller design, guided vane, pump casting.

Unit III **Fans:** Fan laws, performance coefficients, effect of change in fan speed, density. Series and parallel operation, fan design losses, blade shape, casings.

Unit IV **Propeller Fans:** Cross flow fans, principle of operation, applications, regulation of volume flow. Sources of vibration in fans, noise, attenuation testing.

Unit V **Blowers:** Types, centrifugal and axial, design procedure, selection, performance, special application, control of volume flow.

Unit VI **Performance Estimation:** Instrumentation test rig layout, measurement of pressure, temperature, use of hot wire anemometer, boundary layer probes, measurement of sound.

Unit VII **Compressors:** Centrifugal compressor, multistage arrangement, blade design, types of diffusers, performance, series and parallel operation.

Unit VIII **Axial Flow Compressors:** Cascade theory, efficiency, two dimensional cascade, velocity triangles and stage loading, stage reactions, losses compressor testing procedure.

Course Outcomes:

To understand the basic design aspects, working and operation principle of pumps, fans, blowers and compressors.

Text Books:

1. Val, S. Lobanoff, and Robert, R. Ross, “Centrifugal Pumps Design and Application”, Jaico Publishing House
2. Allam Wallis, R., “Axial Flow and Ducts”, John Wiley and Sons

Reference Books:

1. Ronald, P. Lapina, “Estimating Centrifugal Compressor Performance”, Gulf Pub. Company

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 460 E DESIGN OF AIR CONDITIONING SYSTEMS*(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To teach students how to apply the knowledge of heat transfer and air conditioning in designing.
2. To teach students how to apply the knowledge for designing air distribution systems.
3. To teach students how to apply the knowledge of cooling load estimation in designing HVAC system.

Unit - I **Air Conditioning Systems, Hydronic Piping Systems and Terminal Units:**
Scope of air conditioning, All-water (Hydronic) air- conditioning systems, All-air air-conditioning systems, Human comfort, Comfort standards, Hydronic piping systems - Piping arrangements, Series loop, One-pipe main, Two-pipe direct and revere returns, Three-pipe and four pipe systems, Terminal units- Radiators, Convectors, Baseboard, Fin-tube, Radiant panels, Unit heaters, Fan-coil and induction units, Selection of terminal units, System design procedure.

Unit – II **Heat Transfer in Building Structures and Load Calculation:**
Fabric heat gain, Overall heat transfer coefficient, Periodic heat transfer through walls and roofs, Empirical methods to evaluate heat transfer through wall and roofs, Infiltration, Passive heating and cooling of buildings, Internal heat gains, System heat gains, Break-up of ventilation load and effective sensible heat factor, cooling-load estimate, Heating-load estimate, Psychometric calculations for cooling.

Unit – III **Psychometric Analysis of the Air Conditioning System:**
Determining moist air properties, The psychrometric chart, Air conditioning processes, Determining supply air conditions, Sensible heat ratio, The RSHR or condition line, Coil process line, The contact factor and bypass factor, The effective surface temperature, Reheat, Part load operation and control, Fan heat gains, Comfort chart.

Unit – IV **Fluid Flow in Piping and Ducts:**
The continuity equation, The flow energy equation, Pressure loss in closed and open systems, Total, static and velocity pressures in piping, Pressure loss in pipe fitting, System pipe sizing, Friction loss from air flow in ducts, duct fittings at fan inlet and outlet, Duct system pressure loss, Duct design methods.

Unit – V **Fans, Air Distribution Devices and Centrifugal Pumps:**
Fan - Types, Performance characteristics, Selection, Ratings, Selection of optimum conditions, Laws, Arrangement and installation, Air distribution devices – Air patterns, Location, Types, Selection, Accessories, Return air devices, Sound and its control, Pumps – Types, Characteristics, Similarity laws, Net positive suction head, The expansion and compression tanks, Air control and venting.

Unit – VI **Planning and Designing the Hvac System:**

Classification of A/C systems- Single zone, Reheat, Multi zone, Dual duct, Variable air volume, All-water systems, Air water systems, Unitary air conditioners, Rooftop units, Air handling units, Procedures for designing a hydronic system, Calculating the heating load, Type, location and selection of terminal units, Piping system arrangements, Flow rates and temperature, Pipe sizing, Duct layout, Pump selection, Boilers selection, Compressor tanks, Procedure for designing and all-air system, Calculating the cooling load, Type of system, Equipment and duct locations, Duct sizes, Air distribution devices,

Course Outcomes:

1. Able to apply knowledge of heat transfer and air conditioning in designing.
2. Able to apply knowledge for designing air distribution systems.
3. Able to apply knowledge for designing HVAC system.

Reference Books:

1. Air Conditioning Principles and Systems by Edward G. Pita, Published by PHI, New Delhi
2. Refrigeration and Air Conditioning by C.P. Arora, Published by TMH, New Delhi.
3. Refrigeration and Air Conditioning by W.F. Stocker and J.W. Jones, Published by TMH, New Delhi.
4. Refrigeration and Air Conditioning by Manohar Prasad,, Published by Wiley Eastern Limited, New Delhi.

Note:

1. ***In the semester examination the examiner will set 8 questions in all covering the entire syllabus and students will be required to attempt only 5 questions.***
2. ***Use of scientific calculator will be allowed in the examination. However programmable calculator and cellular phone will not be allowed.***

ME- 462 E COMPUTER AIDED VEHICLE DESIGN*(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To enable the students to computer aided design of vehicle frame and suspension system, drive line and rear axle, clutch components, and three speed & four speed gear boxes.
2. To provide to the students an understanding of front axle and steering systems of vehicle.

PART-A

Unit I **Vehicle Frame and Suspension**: Study of Loads-Moments and Stresses on Frame Members. Computer Aided Design of Frame for Passenger and Commercial Vehicles. Computer Aided Design of Leaf Springs-Coil Springs and Torsion Bar Springs.

Unit II **Front Axle and Steering Systems:** Analysis of Loads-Moments and Stresses at different sections of Front Axle. Determination of Bearing Loads at Kingpin Bearings. Wheel Spindle Bearings. Choice of Bearings. Determination of Optimum Dimension and Proportions for Steering Linkages ensuring minimum error in Steering.

Unit III **Drive Line and Read Axle:** Computer Aided Design of Propeller Shaft. Design of Final Drive Gearing. Design details of Full-floating., Semi-floating and Three Quarter Floating, Rear Axle Shafts and Rear Axle Housings.

PART-B

Unit IV **Clutch:** Torque capacity of Clutch. Computer Aided Design of Clutch Components. Design details of Roller and Sprag Type of Clutches.

Unit V **Gear Box:** Computer Aided Design of Three Speed and Four Speed Gear Boxes.

Course Outcomes:

1. Understand computer aided design of vehicle frame and suspension system, drive line and read axle, clutch components, and three speed & four speed gear boxes.
2. Understand the front axle and steering systems of vehicle.

Text Books:

1. Dean Averns, Automobile Chassis Design, llliffe Books.
2. Heldt, P.M., Automotive Chassis, Chilton Co., New York.

Reference Books:

1. Steeds.W., Mechanics of Road Vehicles, llliffee Books Ltd., London
2. Giles, J.G. Steering, Suspension and Tyres, llliffee Books Ltd., London,.
3. Newton, Steeds & Garret, Motor Vehicle, llliffee Books Ltd., London,.
4. Heldt, P.M. Torque Converter, Chilton Book Co., New York,

Note:

Q1. In the semester examination, the examiner will set eight questions in all, taking two questions each from Units I, II, III & one question each from Units IV & V. The

students will be required to attempt 3 questions from PART-A & two questions compulsorily from Part-B.

Q2. Use of Software Packages for Analysis and Design of Mechanical Systems may be used for Design Problem.

ME- 464 E MECHATRONICS*(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To impart interdisciplinary knowledge to study modern Electro-Mechanical Devices.
2. To make a bridge between Mechanical, Electronics, Instrumentation, Computer and Controls field.
3. To familiarize the students with all the important elements of a Mechatronic device.
4. To understand the importance of each control action and how to choose a proper controller for an engineering problem.

Unit I **Introduction and Basics**: What is Mechatronics? A Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers; The Mechatronic Approach.

Unit II **Hardware of Measurement Systems:** A review of Displacement, Position Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors / alongwith Performance Terminology; Selection of Sensors; Input Data by Switches; Signal Conditioning; Brief Review of Operational Amplifier; Protection; Fitering; Wheat Stone Bridge; Digital Signals; Multiplexers; Data Acqusition; Digital Signal Processing; Pulse Modulation; Data Presentation Systems – Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration; Problems.

Unit III **Pneumatic, Hydraulic, Mechanical and Electrical Actuation Systems:** Pneumatic and Hydraulic Systems; Directional Control Valves; Valve Symbols; Pressure Control Valves; Cylinder Sequencing; Process Control Valves; Rotary Actuators; Mechanical Systems – Types of Motion, Kinematic Chains, Cams, Gear Trains, Ratchet & Pawl, Belt & Chain Drives, Bearings, Mechanical Aspect of Motor Selection; Electrical Systems; Mechanical & Solid State Switches; Solenoids; D.C. & A.C. Motors; Stepper Motors; Problems.

Unit IV **System Modeling and Performance:** Engg. Systems; Rotational – Translational Systems; Electro-mechanical Systems; Hydraulic – Mechanical Systems; A review of modeling of First and Second Order Systems and Performance Measures; Transfer Functions for first order System, Second Order System, Systems in series & Systems with Feedback Loops; Frequency Response of First Order and Second Order Systems; Bode Plots: Performance Specifications: Stability; Problems.

Unit V **Closed Loop Controllers:** Continuous and Discrete Processes – Lag, Steady State Error; Control Modes; Two- step Mode; Proportional Mode – Electronic Proportional Controllers; Derivative Control – Proportional plus Derivative Control; Integral Control - Proportional plus Integral Control; PID Controller – Operational Amplifier PID Circuits; Digital Controllers – Implementing Control Modes; Control System Performance; Controller Tuning – Process Reaction Method & Ultimate Cycle Method; Velocity Control; Adaptative Control; Problems.

Unit VI **Digital Logic and Programmable Logic Controllers:** A Review of Number Systems & Logic Gates; Boolean Algebra; Kanaugh Maps; Sequential Logic; Basic Structure of

Programmable Logic Controllers; Input/ Output Processing; Programming; Timers, Internal Relays and Counters; Master & Jump Controls; Data Handling; Analogue Input/ Output; Selection of a PLC; Problems.

Unit VII **Microprocessors and Input/Output Systems:** Control; Microcomputer Structure; Micro- controllers; Applications; Programming Languages; Instruction Sets; Assembly Language Programs; Subroutines; Why C Language ? A review of Program Structure, Branches, Loops, Arrays, Pointer; Examples of Programs; Interfacing; Input/ Output; Interface Requirements; Peripheral Interface Adaptors; Serial Communication Interface; Examples of Interfacing; Problems.

Unit VIII **Design and Mechatronics:** Design Process; Traditional and Mechantronics Design; Possible Mechatronics design solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, A Pick & Place Robot, Automatic Camera, Engine Management System & Bar Code Recorder.

Course Outcomes:

1. Construct the block diagram of any physical mechatronics device used in day-to-day life.
2. Calculate the output to input relation of any physical model in the form of a transfer function.
3. Evaluate the performance of any physical system in terms of its performance parameters.
4. Develop the mathematical model of any physical model from any engineering domain.
5. Interface the sensors and actuators of a mechatronic device to the computer/laptop.
6. Recognize the key features of different type of controllers and develop a suitable controller to obtain the desired performance from the system.

Text Books:

Q1. Mechatronics by W. Bolton, Published by Addition Wesley.
Q2. Mechatronics System Design – Devdas Shetty and Richard A. Kolx Brooks/ Cole 1997.

Reference Books:

1. Introduction to Mechatronics and Measuring System: david G. Alciation and Michael B. Hist and Tata McGraw Hill.
2. Mechtronics – Sensing to Implementation - C.R.Venkataraman, Sapna .

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 466 E FLEXIBLE MANUFACTURING SYSTEMS*(Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic overview of automation, types of automation and transfer mechanism.
2. To provide to the students an understanding automated assembly systems, quantitative and operational analysis of assembly machine.
3. To impart knowledge of group technology, optimum machine arrangement & benefits of group technology.
4. To study flexible manufacturing system, material handling, computer controlled system with their application & benefits.
5. To impart in depth knowledge of robotics & sensors used in robotics.

Unit I **Automation:** Types of automation, reasons for automating, automation strategies, Detroit-type automation: Automated flow lines, methods of work part transport, Transfer mechanisms, buffer storage, automation for machining operations.

Unit II **Automated assembly systems:** Design for automated assembly, types of automated assembly systems, part feeding devices, quantitative analysis of the delivery system operation, analysis of a single-station assembly machine, numericals.

Unit III **Group Technology:** Part families, parts classification and coding, types of classification and coding systems. Machine cell design: The composite part concept, types of cell designs, determining the best machine arrangement, benefits of group technology.

Unit IV **Flexible Manufacturing Systems**: Components of an FMS, types of systems, where to apply FMS technology, FMS work stations. Material handling and storage system: Functions of the handling system, FMS layout configurations. Material handling equipment. Computer control system: Computer function, FMS data file, system reports. Planning the FMS, analysis methods for FMS, applications and benefits.

Unit V **Robotic Technology:** Joints and links, common robot configurations, work volume, types of robot control, accuracy and repeatability, other specifications, end effectors, sensors in robotics.

Unit VI **Robot Programming**: Types of programming, lead through programming, motion Programming, interlocks, advantages and disadvantages. Robot languages: Motion programming, simulation and off-line programming, work cell control.

Unit VII **Robot Applications:** Characteristics of robot applications, robot cell design, types of robot applications: Material handling, processing operations, assembly and inspection.

Course Outcomes:

1. Identify basic automation, types of automation and transfer mechanism.
2. Understand different automated assembly systems, quantitative and operational analysis of assembly machine.
3. Understand the technology, optimum machine arrangement & benefits of group technology
4. Understand flexible manufacturing system, material handling, computer controlled system with their application & benefits.
5. Understand the robotics & sensors used in robotics.

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
2. CAD/CAM – Groover M.P, Zimmers E.W, Prentice Hall of India.

Reference Books:

1. Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley and Sons, 1998.
2. Production Management Systems: A CIM Perspective Browne J, Harhen J, Shivnan J, Addison Wesley, 2nd Ed. 1996.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 468 E NON-CONVENTIONAL ENERGY (*Elective – II)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Analyze solar energy technologies.
2. Familiarize the biomass energy conversion technologies.
3. Understand the wind energy and hybrid energy systems.
4. Know concepts of tidal, ocean and geothermal energy systems.
5. Familiarize the operations of direct energy conversion systems.

Unit I **Introduction:** Trends of energy consumption, sources of energy – conventional and renewable, fossil fuel – availability and limitations, need to develop new energy sources.

Unit II **Solar Energy:** Solar radiation characteristics and estimation, Solar Collectors, Flat Plate and concentrating types. Their comparative study, design and material selection, efficiency. Selective paints and surfaces. Heating of air and water for building and other uses. Thermal storages, Solar Ponds, Solar pumps, solar Power, Solar Cookers etc. Direct Conversion of Solar energy to electricity and its various uses, materials, limitations and costs.

Unit III **Bio-conversion:** Generation of bio-gas, digesters and their design, selection of material, feed to digester, paralytic gasification, production of hydrogen, Algae production and the their uses.

Unit IV **Wind Energy:** Types of rotors, horizontal axis and vertical axis systems, system design and site selection.

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

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

Unit VII **Ocean Thermal Energy:** Principle of utilization and its limitations, description of various systems.

Unit VIII **Other non-conventional energy sources:** Fluidized bed combustions, heat from waste and other sources.

Course Outcomes:

1. Understand the various energy systems and their working.
2. Design bio-conversion system and solar systems.

Text Books:

1. Solar Energy Utilization – G.D. Rai
2. Solar Heating and Cooling – Duffie and Bakeman

Reference Books:

1. Power Plant Technology – M.M EL – Wakil, McGraw Hill Book Co.

2. Power Plant Engineering – P C Sharma, S K Kataria and Sons

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

Department Elective – III

L	T	P	Credit
3	1	----	3.5

Eighth Semester

CODE	Subject	L	T	P	CREDIT
ME 482 E	Maintenance Engineering	3	1	-	3.5
ME 484 E	Robotics Engineering	3	1	-	3.5
ME 486 E	Ergonomics and Work Place Design	3	1	-	3.5
ME 488 E	Modern manufacturing Process	3	1	-	3.5
ME 490 E	Cryogenics Engineering	3	1	-	3.5
ME 492 E	Entrepreneurship	3	1	-	3.5
ME 494 E	Facilities Planning	3	1	-	3.5
ME 496 E	Gas Turbine & Jet Propulsion	3	1	-	3.5
ME 498 E	Emerging Automotive Technologies	3	1	-	3.5

ME- 482 E MAINTENANCE ENGINEERING*(Elective – III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Impart the knowledge on importance and objectives of maintenance.
2. To familiarize the students with preventive maintenance, condition based maintenance and reliability centered maintenance.
3. Expose the students to application of computers to maintenance management.

Unit I **Introduction:** Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept maintenance management & terotechnology, relationship with other functional areas, importance of maintenance, elements of good maintenance, economics of maintenance, training and safety aspects in maintenance.

Unit II **Maintenance Strategies:** Classification of maintenance programs, corrective, preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance- concept functions, benefits, limitations.

Unit III **Condition Based Maintenance (CBM):** Objectives, what to monitor, when to monitor, principles of CBM, condition based maintenance techniques, manual inspections, performance monitoring, vibration monitoring, current monitoring, oil debris/spectroscopy, thermography and corrosion monitoring, steps in implementation of CBM, benefits of CBM.

Unit IV **Reliability Centred Maintenance (RCM):** RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM, methodology, evaluation and benefits.

Unit V **Non-Destructive Testing (NDT):** Purpose and challenges; Techniques, visual aids-boroscopes, endoscopes, fibre obtics scanners, magnetic particles inspection, liquid penetrants, eddy current, ultrasonic radiography, selection of NDT techniques, merits/demerits and applications of various techniques.

Unit VI **Maintenance Planning and Control:** Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance productivity areas for improvement.

Unit VII **Reliability, Maintenance & Availability:** Techniques for improvement of operational reliability, safety and availability of machines and production systems, maintainability criteria, checklist to assess the maintainability of a system, maintainability programs, objectives, key issues in availability improvement program, fault diagnosis, pareto principle Ishikawa diagram.

Unit VIII **Application of Computers to maintenance management:** Data processing systems for integrated maintenance, maintenance information and reporting systems.

Course Outcomes:

1. Understand the importance and objectives of maintenance.
2. Understand the difference between preventive maintenance, condition based maintenance and reliability centered maintenance.
3. Understand the uses and applications of computers to maintenance management.

Text Books:

1. Maintenance planning and control - Higgin L.R. Mc Graw Hill Book Company
2. Maintenance planning and control - Kelley Anthony, East-West Press Pvt. Ltd.,

Reference Books :

1. Maintainability principle and practices – Blanchard B.S., Lowey E.E., Mc Graw Hill.
2. Practical NDT – Raj B., Jayakumar T., Thavasimutyi K., Narora Publishing House.
3. Engineering maintenance management – Niebel Benjamin W., Marcel Dekher.

Note: Eight questions will be set by the examiner, taking at least one question from each unit. Students will be required to attempt five questions.

ME- 484 E ROBOTICS ENGINEERING*(Elective – III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

To introduce the students to the standard terminologies, applications, design specifications, and mechanical design aspects both kinematics, Trajectory planning, work cell control and dynamics of industrial robotic manipulators.

Unit I **Robotic Manipulation**: Automation and Robots; Robot Classification – Drive Technologies, Work-Envelope Geometries, Motion Control Methods, Applications; Robot Specifications – No. of Axes, Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision, Accuracy, Operating Environment, An Example; Rhino X-3.

Unit II **Direct Kinematics:** The Arm Equation Homogenous Co-ordinates – Frames, Translations and Rotations, Composite Homogenous Transformations; Screw Transformations; Link Co-ordinates; The Arm Equation; A Five-Axis Articulated Robot; A Four-Axis Scara Robot; A Six-Axis Articulated Robot; Problems.

Unit III **Inverse Kinematics:** Solving the Arm Equation: The Inverse Kinematics Problem; General Properties of Solutions; Tool Configuration; Inverse Kinematics of a Five-Axis Articulated Robot, Four-Axis Scara Robot, Six-Axis Articulated Robot and Three-Axis Planer Articulated Robot; A Robotic Work Cell; Problems.

Unit IV **Work Space Analysis and Trajectory Planning:** Work Space Analysis; Work Envelope of a Five-Axis Articulated Robot; Work Envelope of a Four Axis Scrara Robot; Work Space Fixtures; The Pick and Place Operation; Continuous Path Motion; Interpolated Motion; Straight Line Motion; Problems.

Unit V **Differential Motion and Statics:** The Tool Configuration Jacobian Matrix; Joint – Space Singularties; Generalised Inverses; Resolved – Motion Rate Control; $n > 6$; Rate Control of Reduntant Rebots : $n > 6$; Rate Control using (1) – Inverses; The Manipulator Jacobian; Induced Joint Torques and Forces; Problems.

Unit VI **Manipulator Dynamics:** Lagrange's Equation; Kinetic & Potential Energy; Generalised Force; Lagrange – Euler Dynamic Model; Dynamic Models of a Two-Axis Planer Articulated Robot and A Three-Axis SCARA Robot; Direct & Inverse Dynamics; Recuresive Newton - Euler Formulation; Dynamic Model of a One-Axis Robot; Problems.

Unit VII **Robot Control:** The Control Problems; State Equations; Constant Solutions; Linear Feedback Systems; Single-Axis PID Control; PD-Gravity Control; Computed –Torque Control; Variable-structure Control; Impedance Control; Problems.

Course Outcomes:

1. Apply the concepts of coordinate transformations for development of arm equation and subsequently the inverse kinematics model for given serial manipulator.
2. Apply the concepts of robotic workspace analysis for design of robotic manipulator for required work cell applications.
3. Design and analyze the work cell environment for given robotic manipulator configuration and work cell devices for required integrated industrial application.
4. Develop and analyze the mathematical model for trajectory planning, resolved motion rate control and dynamics model for a given serial robotic manipulator.
5. Develop the algorithms for design of robotic work cell controller and its programming for given serial robotic manipulator.

Text Books:

1. Fundamental of Robotics (Analysis &Control) by Robert J.Schilling, Published by PHI, Pvt. Ltd., New Delhi.
2. Introduction to Robotics (Mechanics&Control) by John J. Craig, Published by Addition Wesley (Intl. Student Edition).

Reference Books:

1. Analysical Robotics & Mechatronics by Wolfram Stadler, Published by Mc-Graw Hill, Inc., New Delhi.
2. Industrial Robotics - Technology, Programming &Applications byMikell P. Grover, Weiss, Nagel and Ordef, Published by Mc-Graw Hill International Edition.
3. A Robot Engg. Test Book - Mohsen Shahinpoor, Harper & Low, Publishing New York.
4. Robotic Engineering – An Integrated Approach: Richard D.Klafter, Thomas A. Chmielewski and Michael Negin PHI 1989.
5. Foundations of Robotics Analysis and Control - Tsuneo Yashikawa MIT Press 1990, Indian Reprint 1998.
6. Robots and Control - R.K.Mittal and I.J.Nagrath - Tata McGraw Hill 2003.

Note: In the semester examination, the examiner will set eight questions, at least one question from each unit. The students will be required to attempt only 5 questions.

ME- 486 E ERGONOMICS AND WORK PLACE DESIGN*(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic concept of ergonomics.
2. To provide to the students Application of Ergonomics Principles with usability.
3. To impart knowledge of relation between ergonomics and job profile.
4. To impart in depth knowledge of ergonomics case study is demonstrated with work place design.

Unit I Basic Principles of Ergonomics, Anthropometry, Posture and Health; Anthropometry Practical; Displays, Controls and HMI; Tools and Equipment Design; Workplace Design and Assessment; Task Analysis; Questionnaire and Interview Design; Product Design and Evaluation; Designing for manufacture and maintenance; Health and Safety Legislation and Ergonomics.

Unit II Application of Ergonomics Principles, Cognitive Ergonomics, Human Information Processing; Memory; Reading; Perception; Navigation; Problem Solving; Decision Making, Human-Computer Interaction, Input/Output Technology, Usability; Evaluation; Health problems.

Unit III Future Systems, Job Design, Scientific Management, Enrichment, Enlargement, Rotation, Cells, Shift work, Management Style and Job Design, Change Management. New Technology, Unemployment, Deskilling, Introducing new technology. Questionaire design and assessment. Task analysis techniques. Measurement of human error and risk. Use of simulation and prototypes. Product Evaluation. Experimental Design.

Unit IV Case Studies: A set of case studies will be used to demonstrate how ergnomics has lead to changes in work activity, safety and product design. Case studies will include advanced computer applicatons, workplace assessment and re-design, accident analysis and industrial inspection, and in manufacturing. Students will be required to apply the principles to a real life ergonomic design as applied to a product, service or computer application.

Course Outcomes:

1. Identify basic concept of ergonomics.
2. Understand the working and applications of Ergonomics Principles with usability.
3. Understand relation between ergonomics and job profile.
4. Understand different metal forming techniques, extrusion, rolling, drawing and sheet metal forming and shearing operations.
5. Understand the ergonomics practically.

Text Books:

1. Work Design: Industrial Ergonomics – Knoz, Stephan A., Johnson, Steven, Holcomb Hathaway, Scottsdale, AZ.
2. Human factors in engineering and design – Sanders, M.S. & McCormick, E.J., 6th ed., McGraw-Hill, New York.

Reference Books:

1. Ergonomics: Man in his working environment- Murrell, K.F.H, Champan & Hall, London.
2. Man – Machine Engineering – Chapanis A: Wordsworth Publishing Co.
3. The Practice and Management of Industrial Ergonomics – Alexander, D.C., Prentice-Hall, Englewood Cliffs, NJ.
4. Textbook of Work Physiology – Astrand, P.O. & Rhodahl, K.– McGraw-Hill, New York.
5. Human Factors in Lighting – Boyce, P.R. Macmillan, New York.
6. The Ergonomics of Workspaces and Machines : A design manual – Clark, T.S. & Corlett, E.N. Taylor & Francis, London.
7. Ergonomics at work. Oborne, D Wiley, London.
8. Bodyspace–Anthropometry, Ergonomics and Design. – Pheasant, S. Taylor & Francis.

Note: In the semester examination, the examiner will set eight questions in all, taking at least two questions from each unit. The students have to attempt 5 questions.

ME- 488 E MODERN MANUFACTURING PROCESSES*(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. Learn the modern mechanical metal removal process such as ultrasonic machining (USM), abrasive jet machining (AJM), and water jet machining (WJM).
2. To understand the chemistry and material characteristics of electrochemical machining and (ECM) electrochemical grinding (ECG) processes.
3. To study the thermal metal removal processes which include electric discharge machining (EDM), wire cut EDM, and laser beam machining (LBM).
4. To understand the theory and mechanism of plasma arc machining (PAM) and electron beam machining (EBM) processes.

Unit I **Mechanical Processes:** Ultrasonic Machining- Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitations of the process, advantages and disadvantages. Abrasive Jet Machining- Variables in AJM, metal removal rate in AJM. Water Jet Machining- Jet cutting equipments, process details, advantages and applications.

Unit II **Electrochemical and Chemical Metal Removal Processes:** Electrochemical Machining- Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical Grinding - Material removal, surface finish, accuracy, advantages, applications.

Unit III **Thermal Metal Removal Processes:** Electric Discharge Machining (EDM) or spark erosion machining processes, mechanism of metal removal, spark erosion generators, electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection, applications. Wire cut EDM. Laser beam machining (LBM)- Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations.

Unit IV **Plasma Arc Machining (PAM):** Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C. plasma torch unit, safety precautions, economics, other applications of plasma jets. Electron Beam Machining (EBM) - Generation and control of electron beam, theory of electron beam machining, process capabilities and limitations.

Course Outcomes:

1. Select the major variables affecting the performance of USM, AJM, and WJM processes.
2. Compute the work material characteristics of ECM and ECG processes.
3. Select the operating parameters for EDM, Wire cut EDM and LBM processes.
4. Choose the PAM or EBM according to process capabilities.

Text Books:

1. Modern Machining Processes – P.C.Pandey, H.S.Shan, Tata McGraw Hill.
2. Machining Science- Ghosh and Malik, Affiliated East-West Press.

Reference Books:

1. Non Traditional Manufacturing Processes- Benedict G.F, Marcel Dekker.
2. Advanced Methods of Machining- Mc Geongh J.A, Chapman and Hall.

Note: In the semester examination, the examiner will set eight questions in all, taking at least 2 questions from each unit. The students will be required to attempt only five questions.

ME- 490 E CRYOGENIC ENGINEERING*(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To introduce students to low temperature engineering and behaviour of materials.
2. To develop students' skills to perform the analysis and design ofcryogenic systems and cryovessels.
3. To enable the students study the principles of cryogenic instrumentation.
4. To introduce students to cryogenic applications.

Unit I **Introduction:** Limitations of vapour compression system for production of low temperature, multistage system, cascade system, production of solid carbon dioxide, magnetic cooling.

Unit II **Cryogenic Gases:** Properties of cryogenic fluids – oxygen, nitrogen, air, hydrogen and helium, Joule- Thomson effect and liquefactions of gases, liquefaction of air, hydrogen and helium, critical components of liquefiers, rectifier columns, separation of air, separation of helium from natural gas, distillation of liquid hydrogen, purification.

Unit III **Low Temperature Thermometry:** Temperature scales, gas-vapour pressure thermometry, adiabatic demagnetization.

Unit IV **Insulation:** Vacuum insulation; gas filled powders and fibrous materials, solid forms, comparison of various insulating materials.

Unit V **Storage:** Types of insulated storage containers, various design considerations, safety aspects – flammability hazards and high-pressure gas hazards.

Unit VI **Transportation:** Two phases flow, transfer through insulated and un-insulated lines, liquid line indicators, pumps and valves for cryogenic liquids.

Unit VII **Applications:** Industrial applications, research and development; Mechanical, thermal and thermoelectric properties of structural materials at cryogenic temperatures.

Course Outcomes:

1. Possess basic knowledge of cryogenics.
2. Design cryogenic systems and cryovessels.
3. Find applications of cryogenics.
4. Demonstrate the knowledge of cryogenic instrumentation.

Text and Reference Books:

1. Cryogenics and refrigeration – Coldin
2. Experimental techniques in low temperature physics – G.K. White, Clayrendon Press, Oxford
3. Cryogenic research and applications – Marshall Sitting and Stephen Kid, D. Van Nostrand Company, Inc USA
4. Cryogenics – Bailey C A.
5. Refrigeration and air conditioning – Spark and Dillo.

Note: In the semester examination, the examiner will set eight questions from each unit. The students will be required to attempt only five questions.

ME- 492- E ENTREPRENEURSHIP *(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic overview of engineering economics.
2. To provide to the students to the calculation of different types of cost for a finished product.
3. To impart basic knowledge for the economic analysis of investment and selection of alternatives.
4. To study the role and characteristics of an entrepreneur.
5. To study the different types knowledge of product planning and development.
6. To provide basic knowledge for the preparation of feasibility project report.

Unit I **Engineering Economics:** Definition and concept, Importance of Economics for engineers, present value, Wealth, Goods, Wants, Value and price, capital, money, utility of consumer and producer goods.

Unit II **Costing:** Introduction, Elements of cost, Prime cost, Overhead, Factory cost, Total cost, Selling Price, Nature of cost, Types of Cost.

Unit III **Depreciation:** Definition and concept, Causes of Depreciation, Methods of calculating depreciation.

Unit IV **Economic analysis of investment and selection of alternatives:** Introduction, Nature of selection problem, Nature of replacement problem, Replacement of items which deteriorate, Replacement of machines whose operating cost increase with time and the value of money also changes with time, methods used in selection of investment alternatives.

Unit V **Entrepreneurship:** Entrepreneurship, Role of entrepreneur in Indian economy, Characteristics of all entrepreneur, Types of entrepreneurs, some myths and realities about entrepreneurship.

Unit VI **Small scale Industries:** Introduction, Role and scope of small scale industries, concept of small scale and ancillary industrial undertaking, How to start a small scale industry, Steps in launching own venture, procedure for registration of small scale industries, various development agencies-their functions and role in industrial and entrepreneurship development, Infrastructure facilities available for entrepreneurship development in India.

Unit VII **Product planning and Development:** Introduction, Requirement of a good product design, product development approaches, Product development process, Elements of concurrent engineering, quality function development, Rapid prototyping, Various controlling agencies involved their role and formalities for getting clearance before starting individual venture.

Unit VIII **Preparation of feasibility Project Report:** Tools for evaluation of techno economic feasibility project report, SWOT analysis.

Course Outcomes:

1. Understand fundamental of engineering economics and Identifying different types of cost analysis.
2. Understand the concept of depreciation and methods used for the calculation of depreciation.
3. Understand role and scope of small scale industries.
4. Understand different types of product planning and developments.
5. Understand basic statistical techniques used to handle the primary data of measuring instruments.

Text Books:

1. The practice of Entrepreneurship - G.G. Meredikh, R.E. Nelson and P.A. Neck
2. Handbook of Entrepreneurship - Rao and Pareek

Reference Books:

1. Automobile Engineering - K.M. Gupta Umesh Publication
2. Engineering Economics - Tarachand
3. Industrial Engineering and Management - Ravi Shankar

Note: The paper setter will set 8 questions taking at least one question from each unit.Students will be required to answer only five.

ME- 494 E FACILITIES PLANNING*(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic factors essential for the site selection of a company.
2. To provide to the students to the basic knowledge of different types of plant layout.
3. To study various types of line balancing.
4. To impart basic knowledge for the handling of materials.
5. To study various material handling equipment.
6. To study the basic procedure for travel charting.

Unit I **General:** Concepts and factors governing plant location, location economics, rural vs. urban plant sites, case studies: - (i) Selection of a site for software company. (ii) Selection of a site for XYZ Company: Analysis of alternatives. Introduction of plant layout, principles and objectives of effective layout, advantages of good layout, symptoms of bad layout. Types of plant layout, their features, application and comparison. Introduction to group technology; its relevance, application and advantages.

Unit II **Planning the layout:** Factors influencing plant layout; material factors, machinery factors, man factors, movement factors, waiting factors, service factors change factors building factors, workstation design, methods of plant and factory layout, plant layout procedure, factory building, types of factory building, building equipments, common problems in plant layout, tool and techniques of layout, operation process chart, flow process chart, flow diagram, string diagram, evaluating alternate layout-various methods.

Unit III **Line balancing:** Objectives in line balancing problems, constraints in line balancing problems, terminology in assembly line, preventive measures to achieve a balanced production line. Types of line balancing. (a) Assembly line balancing. (b) Fabrication line balancing, Heuristic and other method of line balancing, simple numerical problems in line balancing.

Unit IV **Materials handling:** Objectives of materials handling, functions and principles of materials handling, method of material handling system, types of material handling system, material handling engineering survey, basic features of handling, various materials handling considerations including combined handling, space for movements, analysis of handling methods, economical and technical considerations of handling equipment, cost analysis of material handling systems.

Unit V **Material handling equipments:** Introduction, types of material handling equipment, selection and maintenance of material handling equipments, characteristics of material handling equipments such as conveyers, cranes, hoist, mobile equipment's etc. Amount of equipment required and predicting in process inventory by graphical technique.

Unit VI **Travel Chart:** Procedure for travel charting, numerical problem on optimum arrangement of various departments or shops under given constraints and to check their effectiveness.

Course Outcomes:

1. Understand the essential factors for the selection of site of a company.
2. Understand different types of plant layout.
3. Understand the concept of various types of line balancing.
4. Understand the concept of materials handling.
5. Understand different types of material handling equipment.
6. Understand the concept of travel charting.

Text and Reference Books:

1. Plant layout and design -By Moore
2. Plant layout and material handling - By Apple
3. Plant layout- By Shubhin.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 496-E GAS TURBINES AND JET PROPULSION*(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To know about the basics of compressible fluid flow concepts like Mach number and normal shock wave.
2. To learn about the system of operation of gas turbines and compressors.
3. To know about the basics of aircraft propulsion and performance.
4. To know about the basics of rocket propulsion.

Unit I **Compressible Flow**: Wave propagation and sound velocity; Mach number and compressible flow regimes; basic equations for one-dimensional compressible flow, isentropic flow relations; area-velocity relation; normal shock waves, relation between upstream and downstream flow parameters.

Unit II **Gas Turbine Systems and Cycles:** System of operation of gas turbines-constant volume and constant pressure gas turbines; thermodynamics of Brayton cycle; regeneration-inter-cooling, reheating and their combinations; closed cycle and semi-closed cycle gas turbines; gas v/s I.C engines and steam turbines.

Unit III **Compressors:** Classification-positive displacement and dynamic compressors, Operation of single stage reciprocating compressors; best value of index of compression; isothermal efficiency; effect of clearance and volumetric efficiency; multi-stage compression; air motors.

Centrifugal compressors; static and total head values; velocity vector diagrams; slip factor; pressure coefficient and pre-whirl. Axial flow compressors; degree reaction and polytropic efficiency Performance characteristics; surging, choking and stalling.

Unit IV **Combustion Systems:** Types, combustion process, combustion intensity efficiency and pressure loss.

Unit V **Air-breathing Propulsion Systems:** Principle of jet propulsion; analysis and performance characteristics of turbojet, turboprop, ramjet and pulsejet; thrust power and propulsion efficiency.

Unit VI **Rocket Propulsion:** Operating principle; solid and liquid propellants, performance analysis-calculations for specific impulse and propulsive efficiency.

Course Outcomes:

1. To apply their knowledge to solve problems in basic compressible flow, aircraft and rocket engines.

Text and References Books:

1. Gas Turbine Theory – Cohen and Rogers
2. Principle of Jet Propulsion and Gas Turbine – Zucrow M J.
3. Heat Engineering – Vasandani V P and Kumar D S, Metropolitan Book Co Pvt Ltd

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 498 E EMERGING AUTOMOTIVE TECHNOLOGIES*(Elective-III)*

L	T	P	Credit
3	1	----	3.5

Course Objectives:

1. To expose the students to the basic overview of automobile industry with recent trends and researches.
2. To provide to the students an understanding of fuel cell technology and relation with current scenario.
3. To impart knowledge of advancement in engine technology.
4. To impart knowledge of hybrid vehicle.
5. To expose the students to the Integrated Starter Alternator.
6. To impart knowledge of recent advancement in vehicles.

Unit I **The Future Of The Automotive Industry :**Challenges and Concepts for the 21st century. Crucial issues facing the industry and approaches to meet these challenges.

Unit II **Fuel Cell Technology forVehicles:** What is fuel cell, Type of fuel cell, Advantages of fuel cell. Current state of the technology. Potential and challenges. Advantages and disadvantages of hydrogen fuel.

Unit III **Latest Engine Technology Features:** Advances in diesel engine technology. Direct fuel injection Gasoline engine. Diesel particulate emission control. Throttling by wire. Variable Valve Timing, Method used to effect variable Valve Timing. Electromagnetic Valves, Camless engine actuation.

Unit IV **42 Volt System:**Need, benefits, potentials and challenges. Technology Implications for the Automotive Industry. Technological evolution that will occur as a result of the adoption of 42 volt systems.

Unit V **Electrical and Hybrid Vehicles:** Types of hybrid systems, Objective and Advantages of hybrid systems. Current status, Future developments and Prospects of Hybrid Vehicles.

Unit VI **Integrated Starter Alternator:** Starts stop operation, Power Assist, Regenerative Braking. Advanced lead acid batteries, Alkaline batteries, Lithium batteries, Development of new energy storage systems, Deep discharge and rapid charging ultra capacitors.

Unit VII **X-By Wire Technology:** What is X-By Wire, Advantage over hydraulic systems. Use of Automotive micro controllers. Types of censors. Use of actuators in an automobile environment.

Unit VIII **Vehicles Systems:** Constantly Variable Transmission, Benefits, Brake by wire, Advantages over power Braking System. Electrical assist steering, Steering by wire, Advantages of Steering by wire. Semi-active and fully-active suspension system. Advantages of fully active suspension system.

Course Outcomes:

1. Identify basic of automobile industry with recent trends and researches.
2. Understand fuel cell technology and relation with current scenario.
3. Understand the advancement in engine technology.
4. Understand the hybrid vehicle and it's need to world.
5. Understand and fully aware about Integrated Starter Alternator.
6. Identify the recent advancement in vehicles.

Text &Reference Books:

1. Advanced Vehicle Technologies by Heinz Heisler-SAE International Publication.
2. Electric and Hybrid Electric vehicles by Ronald K. Jurgen.- SAE International Publication
3. Electronic Braking, Traction and Stability control-SAE Hardbound papers.
4. Electronics steering and suspension systems- SAE Hardbound papers.
5. 42 Volt system by Daniel J. Holt- SAE International Publication
6. Diesel Particulate emission by J.H. Johnson- SAE Hardbound papers.
7. Fuel Cell Technologies for vehicles by Richard Stobart- SAE Hardbound papers.

Note: In the semester examination the examiner will set 8 questions, at least one question from each unit. Students will be required to attempt five questions.

ME- 408 E COMPUTER AIDED DESIGN & MANUFACTURING LAB

L	T	P	Credit
---	---	2	1.0

Course Objectives:

1. To equip the students with the fundamentals of design and manufacturing software packages and enable them for CAD modelling assignment.
2. To enable the students to implement simple programme for graphics representation using software package.

The students will be required to carry out the following exercises using software packages (e.g. 3D modeling package/ Pro Engineer/ IDEA/ Solid Edge etc.).

1. Implement simple programmes for the graphics representation of

(i) Transformation and projections.

(ii) Conic Sections, cubic splines, and B-splines.

(iii) Surfaces- Bilinear, Bicubic surface patch and Bezier surface.

2. CAD Modelling Assignments.

(i) Construction of simple machine parts and components.

(ii) Modelling of machine components.

- Surface of a Diffuser section, Propeller.
- Gear blank and other mechanical parts.
- Mechanical assembly of parts.

Course Outcomes:

Understand the basic programming and modelling of graphics representation and their evaluation.

ME-410 E INDEPENDENT STUDY SEMINAR

L	T	P	Credit
---	---	4	2.0

The student will select a topic in emerging areas of Mechanical Engineering and study independently. He will give a seminar talk on the same before the committee constituted by the head of the dept. The committee should comprise of at least three faculty members from Thermal, Production & Design specializations.

Course Outcomes

1. Knowledge of technical advancements in the field of mechanical engineering
2. Demonstrate the ability to describe, interpret and analyse technical issues and develop competence in presenting
3. Outline annotated bibliography of research demonstrating scholary skills
4. Prepare a well organized report employing elements of technical writing and critical thinking

ME-412 E GENERAL FITNESS FOR THE PROFESSION

L	T	P	Credit
---	---	2	1.0

Course objective-

Overall development of the student is the key to succeed in his professional career. This course also emphasize on extra- curricular activities along with academics.

At the end of each year students will be evaluated on the basis of their performance in various fields. The evaluation will be made by the panel of experts/examiners/teachers to be appointed by the Principal/Director of the College. A specimen perform indicating the weight age to each component/ activity is given below :-

Name: _____ College Roll No. _____
University Roll No._____ _____
Branch _____ Year of Admission _____

I. Academic Performance (15 Marks) :
(a) Performance in University Examination:-

Sem.	Result	%age of Marks obtained	Number of Attempt in which the Sem. exam. has been cleared
I			
II			
III			
IV			
V			
VI			
VII			

II. Extra Curricular Activities (10 Marks) :

Item	Level of Participation	(Position Obtained)
Indoor Games	_____	_____
(Specify the	_____	_____
Games	_____	
Outdoor Games	_____	
(Specify the	_____	
Games)	_____	
Essay	_____	
Competition	_____	
	_____	
Scientific	_____	

Technical Exhibitions _____
_____

Debate _____
_____
_____

Drama _____
_____
_____

Dance _____
_____
_____

Music _____
_____
_____

Fine Arts _____
_____
_____

Painting _____
_____
_____

Hobby Club _____
_____
_____

N.S.S. _____
_____
_____

Hostel Management Activities _____
_____
_____

Any other Activity (Please Specify) _____
_____
_____

III. Educational tours/visits/Membership of Professional Societies (5 Marks)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

IV. Contribution in NSS Social Welfare Floor Relief/draught relief/Adult Literacy mission/Literacy Mission/Blood Donation/Any other Social Service (5 Marks)

1. _____
2. _____
3. _____
4. _____
5. _____

6. _____

V. Briefly evaluate your academic & other performance & achievements in the Institution (5 Marks)

_____
_____
_____
_____

VI. Performance in Viva voce before the committee (10 Marks)

_____
_____
_____
_____
_____

*Marks obtained 1.( )+II( )+III( )+IV( )+V( )+VI( ) =

**Total Marks:

Course outcome-

1. This course improves presentation and communication skills of a student.
2. Interviews, group discussions are a part of professional life and this course improves all these capabilities of a student.
3. Students participation in extra curricular activities can boost their confidence level.

ME- 414E PROJECT

L	T	P	Credit
---	---	10	5.0

Course Objectives:

1. Apply basics of mechanical engineering in practical problem.
2. Develop drawing, processes, steps involved in manufacturing and analysis procedures.
3. Develop team work.
4. Improve report writing and presentation skills.

Project involving design/ fabrication/ testing computer simulation/ case studies etc. which is commenced in VIIth Semester, will be completed in VIIIth Semester and will be evaluated through a panel of examiners consisting of HOD of the concerned department, project coordinator and one external examiner to be appointed by the University.

The student will be required to submit three copies of his/her project report to the office of the concerned department for record (one copy each for the deptt. Office, participating teacher and college library).

Course Outcomes:

1. Create a model/fabricate a model/conduct experiment/simulate system for the project work carried in Phase-I.
2. Identify the process of the fabrication / manufacturing.
3. Experiment of the model developed.
4. Analyze data and interpret the results obtained.
5. Summarize the results and submit a report.
6. Learn to work as a team.

Member **Member** **Member** **Member** **Member**