COURSE CURRICULUM

DEPARTMENT OF MECHANICAL ENGINEERING

(w.e.f. Session 2013-14)

INSTITUTE OF ENGINEERING & TECHNOLOGY

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COURSE STRUCTURE

B.TECH.(ME)

ABOUT THE PROGRAM

The Department offer 4-Years Undergraduate Program in Mechanical Engineering (B. Tech.). Excellent Facilities in Terms of Equipment and Staff Are Available to Prepare Students As Professional Mechanical Engineers With the Focus on Innovation, Analysis and Development of Technologies. Excellent Infrastructural Facilities Exist for Academic Development of the Students. Te Department believes in the Philosophy That the Students can apply the Theoretical Knowledge to Practice and Exploration That Eventually Leads to Experiential Learning. The Laboratories and Workshops in the Department Have the Finest Equipment and Are Maintained Impeccably. Dedicated Faculty-Members keep Pace with New Trends and Developments in the Sphere of Mechanical Engineering. With Technological Advancement, The Significance of Machines and Tools can Hardly be Debated. The Mechanical Engineering Department Boasts of Strength in the Areas of Production, Thermal Science, Automobile Engineering, CAD/CAM, Designing, Industrial Engineering, Total Quality Management Etc. Constant and Careful Attention to the Departmental Infrastructure has Immensely Helped in Keeping It Up-To-Date, Thus Equipping the Students with the Necessary Tools to Acquire Technical Know-How.

Workshop: It Helps the Students Train Themselves in Machine Shops Consisting of Lathe Machines, Milling Machines, Shaper, Planer, Slotter, Smithy, Carpentry; Welding Etc. Due Attention is Paid in Imparting Fundamental Knowledge to the Students As Well As Specialization of the Subject.

Engineering Mechanics Lab: This Lab Consists of Experimental Set-Ups to Familiarize Students With the Relationship Between External Forces and Behavior of Objects Under Equilibrium in Different Configurations.

Material Science and Testing Lab: This Lab is Equipped with Various Testing Machines Like Universal Testing Machine of 40T Capacity, Torsion Testing Machine, Impact Testing Machine, Hardness Testing Machine, Metallurgical Microscopes, and Polishing Machine Etc.

Fluid Machine Lab: This Lab is Vital for Mechanical Engineering Students. This Lab Contains Turbines Like, Pelton Wheels, Francis and Kaplan of 5 H.P. Capacities. It Also Includes the Working Test Rigs of Hydraulic Ram, Reciprocating and Centrifugal Pumps,

Heat and Mass Transfer Lab: The Lab is well equipped With Appropriate Apparatus Explaining the Principles of Heat Transfer. It Includes the Test Rig of Thermal Conductivity, Specific Heat of Air Test Rigs, Pin Fin Apparatus, Stephen Boltzmann Const. Apparatus, Heat Flux Apparatus Etc.

Kinematics and Dynamics of Machine Lab: This Lab Helps the Students Know About Various Types of Linkage Mechanisms Like Watt, Steering, Quick Return Etc. It Also Includes the Working Kits of Governors, Balancing Equipment, Vibration Kit, Belt Drives, Cam Analysis, Gear Trains, Coriolis Components Etc.

Refrigeration and Air Conditioning Lab: This Lab Enables the Students to Know about Various type of Refrigeration and Air Conditioning Systems. This Lab Consists of Test Rigs of Air Conditioning and Refrigeration.

Measurement Lab: This is An Essential Lab of the Mechanical Engineering Dept. It Consists of Various Measuring Instruments Like Sine Bar, Slip Gauges, Dial Indicators, Pressure Measurements and Measurements and Temperature Measurements Equipments, Filler Gauges, Vernier Calipers Etc.

CAD/CAM Lab: This Lab Includes the CNC Lathe Machine Trainer and CNC Machines. It Also has Simulation Software of Lathe Machine and Milling Machine Along With A Robotic Kit. This Lab Contains 65 Computers of Well Suited Configuration and License Software Like Auto-CAD, Inventor Series & Pro/Engineer.

Automobile Lab: This Lab Contains Various Working Models and Experimental Setups Like 2 Stroke and 4 Stroke Engines, Steering System, Suspension System, Electrical & Lighting System, Fuel Supply and Ignition System Etc.

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	AHM 101	Mathematics - I	3	1	0	4	4
2.	AHP 103/ AHC 101	Engineering Physics/ Engineering Chemistry	3	1	0	4	4
3.	CSE 101	Fundamentals of Computer and Programming	2	0	0	2	2
4.	MEE 104/ MEE 103	Basic Mechanical Engineering/ Applied Mechanics	3	1	0	4	4
5.	EEE 101/ ECE 101	Electrical Engineering/ Electronics Engineering	3	1	0	4	4
6.	AHE 103	English Language Skills for Communication – I	1	1	0	2	2
PRACTICALS							
7.	AHE 185	English Language Lab – I	0	0	2	1	2
8.	MEE 185/ MEE 186	Engineering Workshop Practice Lab/ Engineering Drawing	0	0	2	1	2
9.	AHP 181/ AHC 181	Engineering Physics Lab/ Engineering Chemistry Lab	0	0	2	1	2
10.	CSE 181	Computer Programming Lab – I	0	0	2	1	2
11.	EEE 181/ MEE 183	Electrical & Electronics Lab/ Applied Mechanics Lab	0	0	2	1	2
12.	MEE 197	General Proficiency	0	0	0	1	0

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	AHM 102	Mathematics - II	3	1	0	4	4
2.	AHC 101/ AHP 103	Engineering Chemistry / Engineering Physics	3	1	0	4	4
3.	CSE 102	Problem Solving using Computers	2	0	0	2	2
4.	MEE 103/ MEE 104	Applied Mechanics / Basic Mechanical Engineering	3	1	0	4	4
5.	ECE 101/ EEE 101	Electronics Engineering / Electrical Engineering	3	1	0	4	4
6.	AHE 104	English Language Skills for Communication – II	1	1	0	2	2
PRACTICALS							
7.	AHE 186	English Language Lab - II	0	0	2	1	2
8.	MEE 186/ MEE 185	Engineering Drawing / Engineering Workshop Practice Lab	0	0	2	1	2
9.	AHC 181/ AHP 181	Engineering Chemistry Lab/ Engineering Physics Lab	0	0	2	1	2
10.	CSE 182	Computer Programming Lab – I	0	0	2	1	2
11.	MEE 183/ EEE 181	Applied Mechanics Lab / Electrical & Electronics Lab	0	0	2	1	2
12.	MEE 198	General Proficiency	0	0	0	1	0

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	AHM 201	Mathematics – III	3	1	0	4	4
2.	CEE 201	Environmental Studies	2	0	0	2	2
3.	MEE 201	Fluid Mechanics	3	1	0	4	4
4.	MEE 202	Materials Science	3	1	0	4	4
5.	MEE 203	Strength of Materials	3	1	0	4	4
6.	EEE 207	Electrical Machines & Automatic Control	3	1	0	4	4
PRACTICALS							
7.	MEE 281	Fluid Mechanics Lab	0	0	2	1	2
8.	MEE 282	Materials Science & Testing Lab	0	0	2	1	2
9.	EEE 287	Electrical Machines & Automatic Control Lab	0	0	2	1	2
10.	MEE 297	General Proficiency	0	0	0	1	0
11.	AHE 281	Soft Skills- I	0	0	2	1	2

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	AHM 202	Computer Based Numerical And Statistical Techniques	3	1	0	4	4
2.	AHE 201	Ethics & Values	2	0	0	2	2
3.	MEE 204	Applied Thermodynamics	3	1	0	4	4
4.	MEE 205	Measurement and Metrology	3	1	0	4	4
5.	MEE 206	Manufacturing Science -I	3	1	0	4	4
6.	MEE 207	Kinematics of Machine	3	1	0	4	4
PRACTICALS							
7.	MEE 285	Measurement & Metrology Lab	0	0	2	1	2
8.	MEE 286	Manufacturing Science -I Lab	0	0	2	1	2
9.	MEE 288	Machine Drawing Lab	0	0	2	1	2
10	MEE 298	General Proficiency	0	0	0	1	0
11.	AHE 282	Soft Skills- II	0	0	2	1	2

Fifth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	MBA 301	Industrial Economics	2	0	0	2	2
2.	AHE 301	Technical Writing	2	0	0	2	2
3.	MEE 301	Manufacturing Science-II	3	1	0	4	4
4.	MEE 302	Machine Design – I	3	1	0	4	4
5.	MEE 303	Dynamics of Machines	3	1	0	4	4
6.	MEE 304	Heat & Mass Transfer	3	1	0	4	4
PRACTICALS							
7.	MEE 381	Manufacturing Science-II Lab	0	0	2	1	2
8.	MEE 382	Machine Design –I Lab	0	0	2	1	2
9.	MEE 383	Theory of Machines Lab	0	0	2	1	2
10.	MEE 384	Heat & Mass Transfer Lab	0	0	2	1	2
11.	MEE 397	General Proficiency	0	0	0	1	0
12.	AHE 381	Soft Skills – III	0	0	2	1	2

Sixth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	MBA 304	Industrial Management	4	0	0	4	4
2.	MEE 305	Machine Design -II	3	1	0	4	4
3.	MEE 306	Industrial Engineering	3	1	0	4	4
4.	MEE 307	Fluid Machinery	3	1	0	4	4
5.	MEE 308	Internal Combustion Engine	3	1	0	4	4
PRACTICALS							
6.	MEE 385	Machine Design - II Lab	0	0	2	1	2
7.	MEE 387	Fluid Machinery Lab	0	0	2	1	2
8.	MEE 389	Colloquium (Seminar)	0	0	2	1	2
10.	MEE 398	General Proficiency	0	0	0	1	0
11.	AHE 382	Soft Skills – IV	0	0	2	1	2

NOTE: At The End of VI Semester Each Student has to Undergo Minimum of 4 Weeks of Industrial Training Program.

Seventh Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	MEE 401	Computer Aided Manufacturing	3	1	0	4	4
2.	MEE 402	Refrigeration & Air conditioning	3	1	0	4	4
3.	MEE 461-79	Elective 1	3	1	0	4	4
4.	MEE 403	Computer Aided Design	3	1	0	4	4
5.	MEE 451-60	Open Elective	3	1	0	4	4
PRACTICALS							
6.	MEE 481	CAD/CAM Lab	0	0	2	1	2
7.	MEE 486	Project	0	0	6	3	6
8.	MEE 485	Industrial Training	0	0	2	1	2
9.	MEE 482	Refrigeration & Air-conditioning Lab	0	0	2	1	2
10.	MEE 497	General Proficiency	0	0	0	1	0

Eighth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			CREDITS	CONTACTS HR/WK
			L	T	P		
1.	MEE 404	Automobile Engineering	3	1	0	4	4
2.	MEE 405	Operations Research	3	1	0	4	4
3.	MEE 461-79	Elective - 2	3	1	0	4	4
4.	MEE 461-79	Elective - 3	3	1	0	4	4
PRACTICALS							
5.	MEE 484	Automobile Engineering Lab	0	0	2	1	2
6.	MEE 487	Advanced Software Lab	0	0	2	1	2
7.	MEE 496	Project	0	0	14	7	14
8.	MEE 498	General Proficiency	0	0	0	1	0

List of Open Electives/Electives

S. NO.	CODE	SUBJECT NAME	S. NO.	CODE	SUBJECT NAME
		Open Electives	5	MEE 465	Turbo Machines
1	MEE 451	Soft Computing Techniques	6	MEE 466	Robotics & FMS
2	MEE 452	Total Quality Management	7	MEE 467	Industrial Automation & Control Systems
3	MEE 453	Supply Chain Management	8	MEE 468	Mechanical Vibration
4	MEE 454	Non-Conventional Energy Resources	9	MEE 469	Mechatronics
5	MEE 455	Entrepreneurship Development Program	10	MEE 470	Finite Element Method
6	MEE 456	Project Management	11	MEE 471	Basics of Nano Technology
		Electives	12	MEE 472	Modern Manufacturing Processes
1	MEE 461	Computational Fluid Dynamics	13	MEE 473	Composite Materials
2	MEE 462	Product Development & Design	14	MEE 474	Reliability & Maintenance Engineering
3	MEE 463	Micro Manufacturing			
4	MEE 464	Power Plant Engineering			

SYLLABUS
B.TECH.(ME)

AHM 101: MATHEMATICS I

Credits: 04 **Semester I** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Differential Calculus:** Successive Differentiation, Leibnitz Theorem, Partial Differentiation, Euler's Theorem on Homogeneous Functions, Differentiation of Composite and Implicit Functions, Total Derivatives, Leibnitz Rule of Differentiation Under the Integral Sign, Jacobian, Extreme of Functions of Several Variables, Lagrange's Method of Undetermined Multipliers.	14
II	**Ordinary Differential Equations:** Introduction, Variables Separable & Linear Form of I Order and I Degree ODEs, Linear Differential Equations of N^{th} Order with Constant Coefficients, Euler – Cauchy Equations, Simultaneous Linear Differential Equations. Method of Variation of Parameters, Applications to Engineering Problems.	14
III	**Matrices:** Inverse of Matrix by Elementary Transformations, Rank of Matrix, Solution of Systems of Linear Equations, Linear Dependence And Independence, Complex Matrices, Eigen Values and Eigen Vectors, Cayley–Hamilton Theorem, Diagonalization by Similarity Transformation.	11

Reference Books:

- E. Kreyszig, "*Advanced Engg. Mathematics",* John Wiley & Sons, 9th Ed.
- Peter V.O'Neil, "*Advanced Engg. Mathematics"*, Thomson Learning.
- M.D.Greenberg, "*Advanced Engineering Mathematics"*, Pearson Education Inc.
- Bali &Goyal, "A *Text Book of Engg. Mathematics"*, Infinity Science Press, U.S.A.
- Allen Jeffrey '*Advanced Engineering Mathematics"*, Academic Press, Elseveir.
- B.V.Ramanna, "*Higher Engg. Mathematics"*, TMH.

AHP101: ENGINEERING PHYSICS I

Credits: 03 **Semester I** **L–T–P: 2–1–0**

Module No.	Content	Teaching Hours
I	**Interference:** Interference of light, Principle of superposition and coherence of light, Interference due to division of wave front and division of amplitude, Theory of biprism experiment, wedge shaped films, Newton's rings. **Diffraction:** Diffraction of light, Fresnel and Fraunhofer diffraction, diffraction due to single slit and N-slits, Plane diffraction grating, dispersive power of grating, Rayleigh's criterion and resolving power of grating and application.	10
II	**Polarization:** Introduction to polarization fundamentals, Phenomenon of double refraction, Nicol prism, Production and analysis of plane, circularly and elliptically polarized light, Quarter and half wave plates, Fresnel's theory of optical activity, Specific rotation, Biquartzpolarimeters. **Laser:** Spontaneous and stimulated emission of radiation, Einstein's coefficients, Principle of laser, Ruby laser, Semiconductor laser, coherence, characteristics of laser beam and coherence property, laser applications. **Fiber Optics:** Introduction, Principle of optical fiber, Classification of fibers, acceptance angle and acceptance cone, Numerical aperture, Propagation mechanism and attenuation in optical fiber.	10
III	**Relativistic Mechanics:** Basic Concepts, Inertial & non-inertial frames, Galilean Transformations, Michelson- Morley experiment, Einstein's postulates, Lorentz transformation equations, Length contraction, Time dilation, Addition of velocities, Variation of mass with velocity, Mass energy equivalence.	10

Reference Books:

- Optics – Ajoy Ghatak (TMH).
- Optics-Brijlal & Subramaniam (S. Chand).
- Optical Fibre& Laser - Anuradha De. (New Age).
- Introduction to Special Theory of Relativity - Robert Resnick - Wiely& Sons.
- Fundamental of Physics - Resnick, Halliday & Walker (Wiely).

CSE101: FUNDAMENTALS OF COMPUTER & PROGRAMMING

Credits: 02 **Semester I** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Computer System, Generations of Computers, Classification of Computers. **Introduction to Operating System:** Batch Processing, Multi Programming, Multi User, Multi Tasking and Real Time Operating Systems. **Computer Network:** Introduction, Types and Applications. **Number System:** Decimal, Binary, Hexadecimal and Octal Number Systems and Their Inter Conversions. **Generations of Programming Languages:** Low, Assembly, High and 4GL. **Language Processors:** Compiler, Interpreter and Assembler, Linker, Loader, Algorithms and Flowcharts.	7
II	**Introduction to The C Language:** Structure of a C Program, Standard Input and Output in C, Operators and Expression, Type Conversion. **Control Structures:** Switch- Case, If -Else, While, Do- While and For Loop, Break and Continue Statement, Nested Loops.	7
III	**Array:** Introduction, Single and Multidimensional Arrays- Declaration, Initialization, Address Calculation. **Operations on Arrays:** Insertion, Deletion, Searching and Sorting. **Strings:** Declaration, Initialization, Input and Output of Strings, String Handling Functions.	7

Text Book:

- Behrouz A. Forouzan and Richard F. Gilberg**:** "*Computer Science – A structured Programming Approach Using C*", C Language Learning, 2007.

Reference Books:

- K. N. King, "*C Programming A Modern Approach*", W. W. Norton, 2nd Edition, 2008.
- Kernighan and Ritche, "*The C Programming Language*", PHI, 2nd Edition, 2011.
- P. Dey and M. Ghosh, "*Programming in C*", Oxford University Press 1st Edition, 2000.

Outcome:

At the end of the course, students will be able to understand:

- *A new programming language well enough to implement simple algorithms.*
- *The strengths and weaknesses of programming languages as well as the domains for which they are intended.*
- *The implementation, testing, debugging, and documentation procedures of programs in C.*

EEE101: ELECTRICAL ENGINEERING

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**D C Circuit Analysis and Network Theorems:** Circuit Concepts, Active and Passive Elements, Electrical Energy Sources, Linear & Non-Linear Network, Unilateral and Bilateral Elements, Source Transformation. Kirchhoff's Laws, Loop and Nodal Methods of Analysis, Star-Delta Transformation. **Network Theorems:** Superposition Theorem, Thevenin's Theorem, Norton's Theorem, and Maximum Power Transfer Theorem. **Steady- State Analysis of Single Phase AC Circuits:** AC Fundamentals, Waveforms or Wave Shapes, Average and Effective Values, Form and Peak Factors, Concept of Phasor, Phasor Algebra & Phasor Representation. Analysis of Series, Parallel and Series-Parallel RLC Circuits, Complex Power, Power Triangle, Power Factor, Introduction to Resonance in Series and Parallel Circuits (Numerical Problems).	13
II	**Three Phase AC Circuits & Measuring Instruments:** Generation & Advantages of Three Phase System, Phase Sequence, Star and Delta Connections, Balanced Supply and Balanced Load, Line and Phase Voltage/Current Relations, Three-Phase Power and its Measurement by Two Wattmeter Method. Construction and Working Principles of PMMC, M.I., Single Phase Dynamometer and Induction Type Energy Meter. **Magnetic Circuit & Single Phase Transformer** Analogy Between Electric & Magnetic Circuits, Magnetic Leakage & Fringing, B-H Curve, Hysteresis and Eddy Current Losses, Concept of Mutual and Self Induction, Principle of Operation, Construction, E.M.F. Equation, Equivalent Circuit, Power Losses, Efficiency, OC&SC Test, Voltage Regulation, Introduction to Auto Transformer, Current Transformer and Potential Transformer.	13
III	**Electrical Machines:** Introduction to Electro Mechanical Energy Conversion. **DC Machines:** Construction & Working Principle, Types, E.M.F. Equation and Torque Equation, Applications of DC Motors. **Three Phase Induction Motor:** Construction & Working Principle, Types, Principle of Operation, Concept of Slip, Applications. **Single Phase Induction Motor:** Principle of Operation and Introduction to Methods of Starting, Applications. **Three Phase Synchronous Machines:** Principle of Operation of Alternator, Voltage Regulation and its Determination by Synchronous Impedance Method and Synchronous Motor and their Applications.	14

Text Book:

- D.C. Kulshrestha, "*Electrical Enginerring*", Tata McGraw Hill.

Reference Books:

- T.K. Nagsarkar & M.S.Sukhija, "*Basic Electrical Engineering*", Edition 2008, Oxford University Press.
- H. Cotton, "*Advanced Electrical Technology*", 2nd Edition 2009, Wheeler Publishing.
- W.H. Hayt & J.E. Kennely, "*Engineering Circuit Analysis*", 7th Edition, Mc Graw Hill.
- S.N.Singh, "*Electrical Power Generation"*, Transmission & Distribution, Eastern Economy Edition.
- I. J. Nagarath, "*Basic Electrical Engineering*", 2nd Edition, Tata McGraw Hill.
- D. E. Fitzgerald & A. Grabel Higginbotham, "*Basic Electrical Engineering*", 5th Edition, McGraw Hill.
- Edward Hughes, "*Electrical Technology*", 3rd Edition, Pearson Education.

MEE101: MANUFACTURING PROCESSES

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Engineering materials, properties and their applications** Engineering Materials-plain carbon steel, alloy steel-tool steel and stainless steel, Non-Ferrous metals and alloys e.g. Cu alloy-brass, bronze, Al alloy-Duralumin, Composite materials. **Machining Processes** Working principles and operations of Lathe, Drilling Machine, Grinding Machine and Shaper.	14
II	**Metal Forming Processes** Introduction to Hot & Cold working processes, eg. – Forging, Rolling, Extrusion and Drawing, Spinning, Bending Stretch Forming and Deep Drawing. **Casting Processes** Introduction to various types of patterns and their allowances. Moulding sand and their properties, preparation of sand moulds, basic concepts of core, gating, runner & riser system, defects in sand casting & their remedies.	13
III	**Fabrication processes** Basic concept and applications of Arc welding, Gas welding, Spot welding, Soldering and Brazing. **Introduction to Advanced Machining Processes** Ultrasonic machining, Electrochemical machining, Electric Discharge machining.	13

Reference Books:

- Chapman WAJ, "*Workshop Technology*" Part 1-3, Viva Books Pvt. Ltd. New Delhi.
- Hajra Chowdhary SK and Hajra Chowdhary AK "*Workshop Technology*" Media Promotors & Publishers.
- Raghuwanshi RS, "*Workshop Technology*" DhanpatRai and Sons, New Delhi.
- Lindberg RA "*Process and Materials of Manufacturing*" Prentice Hall of India, New Delhi
- Jain RK "*Production Technology*" Khanna Publishers, New Delhi.
- Richard L, Little, "*Welding and Welding Technology*" Tata McGraw Hill, New Delhi.
- Taylor HF, Flemming, Merton C and Wulff J, "*Foundry Engineering*" Wiley Eastern Limited, New Delhi.
- Richard WH, Casl RL, Jr. and Philip C. Rosenthal, "*Principles of Metal Casting*" Tata McGraw Hill Publication Company Ltd., New Delhi.
- Jain V.K., "*Advanced Machining Processes*", Allied Publishers, New Delhi.
- Jain K.C. and Chitale A.K., "*Text book of Production Engineering*" PHI Publication.
- Gupta, H.N., Gupta, R.C., Mital, Arun, "*Manufacturing Processes*", New Age Publication.

ECE101: ELECTRONICS ENGINEERING

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Transport phenomenon in semiconductors:** Semiconductor materials; Intrinsic and Extrinsic semiconductors; Mass-action law, Drift and diffusion of charge carriers. **Junction diodes:** P-N Junction diode: construction, operation & characteristics; Zener and Avalanche breakdown mechanisms; Diode resistance and capacitance; Photo-diode and LED. **Diode applications:** Rectifiers: half wave, full wave : Centre-tapped and bridge type.; Filters; Clippers; Clampers; Voltage Multipliers; Zener diode as voltage regulator; Regulated power supply.	14
II	**Bipolar Junction Transistor (BJT):** Bipolar junction transistor: construction & operation; CB ,CE, CC configurations & their Characteristics; Operating point; Transistor as a switch; Need of biasing; Biasing methods: fixed bias, emitter bias, potential divider bias, voltage feedback bias; Bias stabilization; Stability factor; h-parameters; Small signal analysis of Single stage BJT amplifier. **Field Effect Transistor (FET):** Construction, operation & characteristics of JFET; Shockley's equation; Depletion& Enhancement type MOSFET; Biasing of JFET:-fixed bias, self bias and voltage divider bias; Biasing of depletion type & enhancement type MOSFET.	14
III	**Digital Electronics:** Number systems; Binary Addition & Subtraction;1's and 2's complement , Subtraction using 2's complement; Boolean algebra; Logic gates; Implementation of basic gates using universal gates; Realization of Boolean functions using basic & universal gates; Canonical forms(SOP & POS); Simplification of Boolean functions using Boolean postulates & K-map up to 4 variables with don't care condition. **Operational Amplifier (Op-Amp):** Operational amplifier: Block diagram, ideal and practical Op-Amp characteristics; Inverting, non-inverting and differential configurations (open loop and closed loop); Applications of Op-Amp as buffer, adder, subtractor, integrator and differentiator.	13

Reference Books:

- Robert L. Boylestad and Louis nashel sky, "*Electronic devices and circuit theory*", Pearson Education/PHI, New Delhi.
- Morris Mano, "*Digital design*", Pearson Education.
- R.A. Gayakwad, "*Op-amps & linear Integrated circuits*", PHI.
- R.J. Smith and R.C. Dorf, Circuits, "*Devices and System,*" Willey, 5th edition.
- Jacob Millman and Christos C. Halkias, "*Integrated Electronics*", TMH, New Delhi.
- H.S. Kalsi; "*Electronic Instrumentation*", TMH, New Delhi.

AHE183: ENGLISH IN PRACTICE-1

English in Practice I' focuses on communication activities in functional and situational contexts. It encourages students to speak with fluency and accuracy as well as develop the four skills of reading, writing, listening and speaking. The classes will be theme based to provide practice in a meaningful context which can be extended outside the classroom.

COURSE OBJECTIVE

At the end of the course, the participant should be able to

- Understand and communicate with English speakers from different parts of the English-speaking world.
- Discuss and plan holidays in English.
- Understand and tell jokes and stories.
- Discuss elements of popular culture such as TV, radio and music.
- Talk & write about past, memories and ambitions in English.
- Communicate important personal information in spoken English.
- Discuss health, and that of others, in English.

Credits: 02 **Semester I** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	**STRUCTURAL INPUT** • Use of Articles (written Drill) - Pp 49, & 50, Exercise 1,2,3,4 • Singular & Plural • Gender • Nouns (Pp 61 Writing) • Tenses (Pp 62 to 63, all sections) • Adjectives & Adverbs (Pp 82 Adjective & Adverbs) • Prepositions (Place, Position, Instrument, Agent, Time) – Pp 158 Exercise no.1, 2, Pp 159, Exercise no. 3) *All the grammatical elements should be discussed in the light of the exercises.	**11**
II	**SPEAKING AND LISTENING** Vocabulary of character description Shopping, Holidays (A list of words related to the themes can be provided as a supplement) ACTIVITIES Pp 118, UNIT I, Listening exercise no 1 (Track 002) Pp 119, UNIT 1, Communication Exercise 4 (Track 003) Pp 121, UNIT 3, Listening Exercise 1 (Track 009) Pp 132, UNIT 9, Communication Exercise 4 (Track 026) (Text to be used: Mani. P. *English for Teaching*.) **READING AND WRITING** **Vocabulary of character description** History, Homes and Houses (A list of words can be provided as a supplement) **ACTIVITIES** Pp 33, Describing a Process 1 & 2 [All the sections to be covered in the 2 sessions Pp 37 to 38, Study Skills 1.a, b, c Pp 38, Writing 1 & 2 (Text to be used: *English for Engineers* by RIS, Bangalore.)	**13**

III	**STRUCTURAL INPUT** Usage of Affixes in forming words belonging to different grammatical categories e.g. –al, Ness, -Ed, un-, IM-, -ISH, -ism, etc. • Identification of grammatical categories of the word in sentences • Error correction with reference to Subject & verb agreement (Pp 94 to 98 Exercise 26, K. R. Laxminarayanan, *English for Technical Communication*, Vol. 1 & 2, SciTech Pub. Pvt. Ltd) • Prepositions (Reason, Complement, Ingredient, Beneficiary)	**11**
IV	**SPEAKING & LISTENING** **Vocabulary of character description** Education, Defence (A list of words related to the themes can be provided as a supplement) **ACTIVITIES** Pp 122, UNIT 3, Listening Exercise 2 (Track 010) Pp 121, UNIT 2, Communication Exercise 4 (Track 007) Pp 126 to 127, UNIT 6, Listening Exercise 1 (Track 018) (Text to be used: Mani, P. *English for Teaching*.) **READING & WRITING** **ACTIVITIES** Pp 48 Writing Pp 40 to 43, Reading, Chapter 1 & Comprehension Pp 44, Writing Section1 (Some more activities can be added by faculty) (Text to be used: *English for Engineers* by RIS, Bangalore.)	**9**

Text Book:

- Mani .P & Deepthi, S, "*English for Teaching",* CUP
- Regional Institute of English, *"English for Engineers"*, Bangalore, Foundation Books Pvt. Ltd.

Reference Books:

- Hornby, A.S., "*An Advanced Learners*" Dictionary of Current English, OUP.
- Murphy, Raymond, "*Intermediate English Grammar",* Cambridge University Press.

Material:

- Audio-Video Material available in the language Lab and texts such as Newspapers etc

MEE185: ENGINEERING WORKSHOP PRACTICE LAB

Credits: 01 **Semester I/II** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**List of Experiments** • To study the working of basic machine tools like Lathe m/c, Shaper m/c, Drilling m/c and Grinding m/c. • To perform the following operations on Centre Lathe: • Turning, Step turning and Taper turning • Facing, Grooving and Knurling • To perform the operations of Marking, Filing and Sawing on the given metallic work-piece (M.S.) as per given dimensions. • To perform the operations of drilling of making the holes on the given metallic work-piece (M.S.) by use of Drilling machine. • To perform the operations of making external and internal threads by use of Tapes and Dies. • To develop the blank dimensions for the given product using development process. • To prepare a Funnel of required dimensions using joining processes. • To prepare Lap/Butt joint by an Electric Arc welding. • To prepare Lap/Butt joint by Gas welding. • To perform different operations in Carpentry shop such as cutting, planning and chiseling on the given wooden piece. • To prepare a joint (Lap/T) by using wooden specimen/piece. • To prepare a Sand mould for solid casting with the help of given pattern. • To prepare the mould for hollow casting with the help of pattern and core. • To prepare square bolt head by upsetting process in Black Smithy shop.	36

Outcome: At the end of the course the student will be able to

- Know the practical skills to work with the range of various machining operations
- Understand and comply with workshop safety regulations.

AHP181: PHYSICS LAB

Credits: 01 **Semester I/II** **L–T–P: 0–0–2**

Any twelve experiments, at least five from each group

Module No.	Content	Lab Hours
I	**Group -A** • To determine the wavelength of monochromatic light by Newton's rings. • To determine the wavelength of monochromatic light with the help of Fresnel's biprism. • To determine the focal length of two lenses by nodal slide and to locate the position of cardinal points. • To determine the specific rotation of cane sugar solution using polarimeter. • To determine the wavelength of spectral lines using plane transmission /diffraction grating. • Measurement of wavelength of laser (He- Ne) light using single slit diffraction • To verify Stefan's law by electrical method. • To determine the coefficient of viscosity of water by Poiseuille's method. **Group – B** • To determine the specific resistance of the material of a given wire using Carey Foster's bridge. • To study the variation of magnetic field along the axis of current carrying circular coil and then to estimate the radius of the coil. • To calibrate the given ammeter by potentiometer. • To calibrate the given voltmeter by potentiometer. • To study the Hall Effect and determine Hall coefficient, carrier density and mobility of a given semiconductor. • To determine the energy band gap of a given semiconductor material. • To determine E.C.E. of copper using Tangent or Helmholtz galvanometer. • To draw hysteresis curve of a given sample of ferromagnetic material and then to determine the magnetic susceptibility and permeability of the given specimen. • To determine the ballistic constant of a ballistic galvanometer. • Measurement of fiber attenuation and aperture of optical fiber. • To determine high resistance by leakage method.	24

CSE181: COMPUTER PROGRAMMING LAB

Credits: 01 **Semester I** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**Arithmetic operations** • WAP to perform arithmetic operation over the variables. • WAP to calculate area of the circle. • WAP to find the sum of digits of a number. • WAP to find the reverse of a string.. • WAP to implement perimeter of a rectangle **Function** • WAP to call a function by reference. • WAP to call a function by value. • WAP to calculate factorial of a number. • WAP to print a table of a user define number. • WAP to generate Fibonacci Series **Pointer** • WAP to display the contents of 2D array using pointer. • WAP to sort an array in ascending order using dynamic memory allocation and pointers. **Microsoft Office** • MS Word Introduction. • MS Excel Introduction • MS PowerPoint Introduction. • MS Paint brush Introduction. **Pattern** • **WAP to Design the Following Pattern** *	24

EEE181: ELECTRICAL & ELECTRONICS LAB

Credits: 01 **Semester I/II** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**LIST OF EXPERIMENTS:** • To verify the Thevenin's theorem (DC circuits). • To verify the maximum power transfer theorem (DC circuits). Also draw graph between power and load resistance. • To verify the Superposition Theorem (DC circuits). • To study the phenomenon of resonance in R-L-C series circuit and to draw graph between frequency and current. Also show half power points. • To determine the V-I characteristics of a semiconductor diode. Also calculate forward and reverse static and dynamic resistances. • To study the half wave and full wave (center tapped) rectifier with and without filter. Also to calculate the ripple factor in both cases (without filter). • To study single phase (induction type) energy meter. • To study various logic gates such as OR, AND, NOT, NAND, NOR. • Study of CRO and measurement of voltage and frequency using CRO. • V-I characteristics of Zener diode. • Identification of active and passive components. • V-I characteristics of bipolar junction transistor in common base mode.	24

AHM102: MATHEMATICS – II

Credits: 04 **Semester II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Multiple Integrals:** Double and Triple Integrals, Change of order of integration, Change of variables, Beta and Gamma functions. Applications to Dirichlet integrals. **Fourier Series:** Fourier series of period 2π, Even and Odd functions, Fourier series for discontinuous functions, Half range sine and cosine series Change of interval.	14
II	**Partial Differential Equations:** Solution of I order Lagrange's linear PDEs, Linear PDEs with constant coefficients, Classification of II order PDEs, Method of separation of variables, One dimensional wave equation, D' Alembert's solution, Heat conduction equations up to two dimensions.	12
III	**Laplace Transform:** Properties of Laplace transform, Existence theorem, Laplace transform of derivatives and integrals, Unit step and Dirac - delta function, periodic functions, Partial Fractions, Properties of inverse Laplace transform, convolution theorem. Application to ODEs and integral equations.	14

Reference Books:

- E. Kreyszig: "*Advanced Engg. Mathematics*", 9th Ed., John Wiley & Sons.
- Peter V.O'Neil: "*Advanced Engg. Mathematics*", Thomson Learning.
- M.D.Greenberg: "*Advanced Engineering Mathematics*", Pearson Education Inc.
- Bali &Goyal: "*A Text Book of Engg. Mathematics*", Infinity Science Press, U.S.A.
- Allen Jeffrey: "*Advanced Engineering Mathematics*", Academic Press, Elseveir.
- B.V.Ramanna: "*Higher Engg. Mathematics*", TMH.

AHP102: ENGINEERING PHYSICS – II

Credits: 03 **Semester II** **L–T–P: 2–1–0**

Module No.	Content	Teaching Hours
I	**Electromagnetics :** Inconsistency in Ampere's Law, Displacement Current, Equation of Continuity, Maxwell's Equations (Integral and Differential Forms), Propagation of E-M Waves in Free Space and in Conducting Media, Poynting Theorem and Poynting Vector. **Electric and Magnetic Fields in Matter:** Dielectric Behavior of Materials, Clausius-Mossotti Relation, Piezoelectricity (Qualitative), Magnetization, Dia, Para and Ferromagnetism, Langevin's Theory for Dia and Para Magnetism.	16
II	**Solid State Physics:** Formation of Energy Bands in Solids. Intrinsic & Extrinsic Semiconductors, Donor and Acceptor Impurities, Fermi Level and Fermi Energy, P-N Junction Formation, Temperature Dependence of Conductivity and Mobility, Hall Effect. Origin of Superconductivity, Meissner Effect, Type-I & Type-II Super Conductors, London's Equation, Application of Superconductors. **Nanomaterials:** Basic Principle of Nanoscience and Nanotechnology, Nanostructures, Bucky balls: Creation & Uses, Synthesis and Characterization of Carbon Nano-Tube (CNT), Application of Carbon Nanotubes.	14
III	**Wave Mechanics:** Wave Model, Wave- Particle Duality, Photoelectric Effect, De-Broglie Hypothesis. **Phase and Group Velocities:** Wave packet, Heisenberg's Uncertainty Principle and its Applications, Wave Function and its Normalization. **Schrödinger's Wave Equation:** Time Dependent and Time Independent Wave Equations, Particle in One Dimensional Potential Box. **X-Ray Diffraction:** Diffraction of X-Rays by Crystal Planes, Bragg's Law, Bragg's Spectrometer, Compton's Effect.	14

Reference Books:

- Beiser, "*Concept of Modern Physics*", Tata Mc-Graw Hill.
- Kittel, "*Solid State Physics*", 7th edition, Wiley Eastern.
- S.O. Pillai, "*Solid State Physics*", 5th edition, New Age International Publication.
- V. Raghavan, "*Materials Science and Engineering,*" Prentice Hall India.
- Rechard Booker and Earl Boysen, "*Nanotechnology*", Wiley International Publishing.
- David J. Griffith, "*Introduction to Electrodynamics*", Prentice Hall of India.

CSE102: PROBLEM SOLVING USING COMPUTERS

Prerequisite: *Fundamentals of Computer & Programming (CSE101).*

Credits: 02 **Semester II** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Pointers:** Declaration and Initialization of Pointer Variables, Accessing a Variable Through its Pointer, Pointer Arithmetic, Array of Pointers, Pointer to an Array. **Functions:** Declaration and Definition, Category of Functions, Parameter Passing Techniques – Call by Value and Call By Reference, Passing Arrays to Functions. **Introduction To Storage Classes** – Auto, Static, Extern and Register.	7
II	**Recursion:** Mechanics of Recursive Call, Implementation of Recursion, Recursion vs. Iteration. **User Defined Types:** Enum, Typedef, Union and Structure - Declaration, Initialization, Nested Structures, Arrays of Structures, Structure and Pointer, Passing Structure Through Function. Difference Between Structures and Union.	7
III	**The C Preprocessor:** Introduction, Macro Expansion and File Inclusion. **File Handling:** Data And Information, File Concepts, File Organization, Files In C, File Operations: Open, Read, and Close, Trouble in Opening a File. File Opening Modes, Working with Text Files. **Introduction to Data Structures** – Stack, Queue and Linked List and its Basic Operation.	7

Text Book:

- Behrouz A. Forouzan and Richard F. Gilberg, "*Computer Science – A Structured Programming Approach Using C*", C Language Learning (2007).

Reference Books:

- K. N. King, "*C Programming a Modern Approach*", W. W. Norton, 2nd Edition (2008).
- Kernighan and Ritche, "*The C programming Language*", PHI, 2nd edition (2011).
- P. Dey and M. Ghosh, "*Programming in C*", Oxford University Press 1st Edition (2000).

Outcome:

At the End of the Course, Students Will be Able to Understand How to:

- *Write Programs that Perform Explicit Memory Management.*
- *Create Programs that Measure or Simulate Performance and Use Them to Analyze Behavior. Write The Programs for Compiler and Operating Systems.*

MEE102: BASIC THERMODYNAMICS

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Basic Concepts** Thermodynamic systems, State & properties, Macroscopic & microscopic point of view. Thermodynamic equilibrium & processes, Zeroth law of thermodynamics, Temperature scales, Work & heat. **First Law of Thermodynamics** First law of thermodynamics, Steady flow energy equation for closed and open systems, Application of first law to various thermodynamic systems such as boiler, turbine, compressor, nozzle, pump etc. Limitations of the first Law of thermodynamics.	14
II	**Second Law of Thermodynamics** Concept of heat engine, Heat pump & refrigerator, Second Law of Thermodynamics, Carnot cycle, Theorems and Corollaries. **Entropy** Clausius Inequality, Concept of entropy, Principle of increase of entropy of universe, Entropy change during various processes, Concept of Third Law of Thermodynamics. **Concept & classification of IC engines** Construction and working of two stroke and four-stroke engines, SI and CI engines. 2 stroke, 4 stroke, SI, CI.	13
III	**Gas power cycles and performance parameter (BP, IP) of IC Engine** Air standard cycles and efficiency, Otto cycle, Diesel cycle, **Properties of Steam** Definition of pure substance, Phase change, p-T diagram and pV-T surfaces, Formation of Steam, Classification of steam generators, Concept and determination of dryness fraction of steam, Thermodynamic properties of steam, Steam table and Mollier diagram. Rankine cycle,	13

Reference Books:

- VaWylen G.J. & Sonnlog R.E.: "*Fundamentals of classical thermodynamics*", John Wiley & Sons, Inc. NY.
- WarkWenneth: "*Thermodynamics*", McGraw Hill book Co. NY.
- Holman, J.P.: "*Thermodynamics*", MC Graw Hill book Co. NY.
- Rogers G and Mayhew Y: "*Engineering Thermodynamics*", Pearson Education.
- Jones J B and Hawkins J A: "*Engineering Thermodynamics*", John Wiley and Sons.
- Joel R.: Basic Engineering "*Thermodynamic*"s, Addison Wesley.
- Nag P. K.: "*Engineering Thermodynamics*", TMH, and India.
- Yadav R.: "*Thermodynamics and Heat Engines*", Vol I & II (Sl Edition) Central Publishing House Allahabad.
- Ballaney P.L.: "*Thermal Engineering*", Khanna Publisher.
- Rajput R.K.: "*Thermal Engineering*", Laxmi Publication.
- Arora C.P.: "*Engineering Thermodynamics*", TMH, India.

AHC101: ENGINEERING CHEMISTRY

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Chemical Kinetics**: Order and Molecularity of Reactions, Zero Order, First Order and Second Order Reactions. Integrated Rate Equations. Theories of Reaction Rates, Factors Affecting Rate of Reaction. **Solid State:** (1 Lect): Types of Unit Cell, Space Lattice (Only Cubes), Calculation of Density of The Unit Cell, Number of Atoms Per Unit Cell, **Chemical Bonding:** M.O. Theory and its Applications in Homo & Hetero Diatomic Molecules. Hydrogen Bond, Metallic Bond and Their Applications. ***Semi-Conductor*** **Organic Name Reactions and Stereochemistry**. Name Reactions ie. Aldol Condensation, Cannizaro Reaction, Types of Isomerism (Optical & Geometrical), Chirality, Element of Symmetry, Diastereomers, Optically Active Compounds, R-S Configuration and E-Z Geometrical Isomers, Conformation of Ethane, N-Butane **Non-Conventional Energy Source**: Introduction to Solar Energy, Biomass and Biogas.	14
II	**Phase Rule:** Introduction, Definition and Explanation of The Terms: Phase, Component and Degree Of Freedom, Application of Phase Rule to One Component System (Water & CO_2 System), Ph, Buffer Solution (Henderson Equation). **Polymers:** Polymerization and its Classification. Thermoplastic and Thermosetting Resins. Properties of Polymers, Molecular Weights of Polymers, Elastomers. Organic Conducting and Biodegradable Polymers (PMMA, Polystyrene, Teflon, Neoprene, Buna-S, Buna-N Nylon 6, Nylon 66, Terylene, PLA, Poly B Hydroxy Butyrate), Vulcanization of Rubber. **Water Treatment:** Introduction, Hardness and its Units,, L-S Process, Calgon Process, Zeolite and Ion-Exchange Resins, Treatment of Municipal Water, Reverse Osmosis, Impurities in Water, Characteristics of Water, Treatment Process Includes Above Deleted Portions, Boiler Feed Water, Boiler Troubles and Remedial Measures **Lubrication:** Introduction to Lubrication, Classification, Properties & Uses.	17
III	**Corrosion**: Introduction, Consequences, Types, Theories of Corrosion, (Galvanic, Pitting, Stress, Water Line, Intergranular & Soil Corrosion) and Protection of Corrosion. Electrochemical Cell, Concentration Cell. **Spectroscopy:** Elementary Ideas and Simple Applications of UV, Visible, Infra-Red and NMR Spectral Techniques **Fuels**: Classification of Fuels. Analysis of Coal, Determination of Calorific Values. ***Synthetic Petrol* Class:** Preparation, Varieties & Uses. **Ceramics:** Introduction, Classification, Scope & Application.	17

Reference Books:

- Morrison Boyd, "*Organic Chemistry ",* (Prentice Hall of India Pvt. Ltd.)
- I.L. Finar, "*Organic Chemistry".*
- Y R Sharma, *"Elementary Organic Spectroscopy",* (S. Chand and Co. Ltd. New Delhi).
- S. S. Dara, *"Text Book of Engg Chemistry",* (S. Chand Technical).
- Shashi Chawla, "*Engg Chemistry*", (Dhanpat Rai & Co. New Delhi).
- K M Mittal, "*Non Conventional Energy System",* (AH Wheelar & Co.)
- Mars G Fontana, "*Corrosion Engg",* (Tata McGraw Hills).
- *"Physical Chemistry"* by Puti, Sharma & Pathania (Vishal Publishers, Jalandhar).
- Chemical Kinetics by Laidler (Pearson Education,, India).
- Bahl and Tuli, "*Physical Chemistry",* (S. Chand and Co. Ltd. New Delhi).

MEE103: APPLIED MECHANICS

Prerequisite: *Knowledge of Intermediate level Physics & Mathematics*.

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction** Engineering Mechanics: Idealization of Bodies, concept of Rigid Body, External Forces, moments, couples, Laws of Mechanics. **Force Systems And Equilibrium** Concurrent forces in a plane, Parallel forces in a plane, Free Body Diagram, Equation of equilibrium and their applications to various systems of forces. **Friction** Concepts of friction, Dry friction, Laws of friction and their applications to wedge, ladder, screw, belt-pulley system, Rolling friction.	14
II	**Distributed Forces and Moment Of Inertia** Centroid of Composite figures, Area Moment of Inertia, Polar Moment of Inertia, Parallel axis theorem, Perpendicular axis theorem, Principle Moment of Inertia, Mass Moment of Inertia of circular ring, disc, cylinder, sphere and cone about their axis of symmetry. **Beams** Different support & load conditions, Shear Force and Bending Moment Diagrams for point load, uniformly distributed load, uniformly varying load.	12
III	**Analysis of Plane Trusses** Engineering structures, Perfect Truss, Determination of axial forces in the members, Method of Joints, Method of Section. **Kinematics of Rigid Body** Plain motion of rigid body, Velocity and acceleration under translation and rotational motion, Absolute motion, Relative motion. **Kinetics of Rigid Body** Force, Mass and Acceleration, Work, Power and Energy, Impulse and Momentum, D' Alembert's Principle and dynamic equilibrium.	14

Text Books:

- "*Engineering Mechanics*" – Statics & Dynamics by Dr. A.K. Tayal, Umesh Publications, Delhi
- "*Engineering Mechanics*" – Statics Vol.I& Dynamics Vol-II by V.S. Mokashi (Tata McGraw- Hill)

Reference Books:

- "*Engineering Mechanics*" – I.H. Shames, Prentice Hall of India Pvt. Ltd., New Delhi (EEE)
- "Mechanics for Engineers" – (Statics and Dynamics) F.P. Beer & E.R. Johnston, TMH New Delhi
- "*Engineering Mechanics*" – Statics & Dynamics by J.L. Marriam& L.G. Kraig, John Wiley & Sons Ltd.

Outcome: At the end of the course the student will be able to

- Understand the representation and analysis of forces, moments, and equilibrium of particles and rigid bodies, concept and principles of work and energy
- Comprehend the effect of friction and its role in engineering applications
- Develop basic know how and awareness to deal with real life applications in various fields of engineering

MEE104: BASIC MECHANICAL ENGINEERING

Prerequisite: *Knowledge of Intermediate level Physics & Mathematics*.

Credits: 04 **Semester I/II** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Fundamentals of Thermal Engineering** Thermodynamic systems, State & properties, Thermodynamic equilibrium & processes, Heat & work, Work done for different polytrophic processes, Zeroth law of thermodynamics and its applications, First law of thermodynamics, Steady flow energy equation, Application of first law to various thermodynamic systems and its limitations.	13
II	**Applications of Thermal Engineering** Concept of heat engine, heat pump & refrigerator, Second Law of Thermodynamics, Carnot theorem. Clausius Inequality, Concept of entropy, Entropy change during various processes, Introduction to 2 stroke and 4 stroke SI & CI Engines. **Metal Forming & Casting Process** Introduction Hot & Cold working processes, forging, rolling, extrusion, types of patterns and their allowances, moulding sand and their properties, concept of gating system.	13
III	**Machining Processes** Working principles and operations of Lathe, Drilling Machine, Grinding Machine and Shaper. **Fabrication processes** Basic principles and applications of Arc welding, Gas welding, Spot welding, Soldering and Brazing.	14

Text Books:

- Nag P. K.: "*Engineering Thermodynamics*", TMH, and India.
- Yadav R.: "*Thermodynamics and Heat Engines*", Vol I & II (Sl Edition) Central Publishing House Allahabad.
- Hajra Chowdhary SK and Hajra Chowdhary AK "*Workshop Technology*" Media Promotors & Publishers.
- Raghuwanshi RS, "*Workshop Technology*" DhanpatRai and Sons, New Delhi.

Reference Books:

- VaWylen G.J. & Sonnlog R.E.: "*Fundamentals of classical thermodynamics*", John Wiley & Sons, Inc. NY.
- WarkWenneth: "*Thermodynamics*", McGraw Hill book Co. NY.
- Joel R.: Basic Engineering "*Thermodynamic*"s, Addison Wesley.
- Chapman WAJ, "*Workshop Technology*" Part 1-3, Viva Books Pvt. Ltd. New Delhi.

Outcome: At the end of the course the student will be able to

- Understand the basic laws of thermodynamics and their applications in engineering
- Understand the processes and operations of metal joining ,fabrication casting and machining with applications
- Develop basic know how and awareness of various manufacturing processes to deal with real life applications in various fields of engineering

AHE184: ENGLISH IN PRACTICE –II

Keeping in mind the diverse set of students (as far as their mother tongues are concerned) in the undergraduate Programs of the University, 'English in Practice- II' focuses on communication activities in functional and situational contexts. It encourages students to speak with fluency and accuracy as well as to develop the four skills: reading, writing, listening and speaking. This course proposes scope for the participants to learn the art of speaking English as standard Indian English speaker. It aims not to prescribe the rules which the participants may find difficult to follow as a non native speaker rather it facilitates them to improve their spoken language without the interference of their mother tongues (MTI).

COURSE OBJECTIVE

At the end of the course, the participant should be able to.

- Read articles on subjects of general interest
- Review grammar and vocabulary so that one is able to speak with more accuracy
- Learn the vocabulary and phrases that are used in social gatherings and networking events
- Listen to news and general interest programs so that one can improve one's ability to understand
- Practice speaking in groups in order to gain confidence by using the language
- Practice speaking in real-life situations

Credits: 02 **Semester: II** **L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	**STRUCTURAL INPUT** It includes more specific phonetic exercises designed to address core problem areas which non-native speakers face, air flow exercises for continuant sounds. It gives an opportunity to get continued feedback on self-correction and transfer of techniques learned in the first course. Topics include: • Contrastive vowel articulation exercises • Words spelled in the same way but pronounced differently • Exercises to distinguish voiced and voiceless continuants, as in words like "ano*th*er or suspi*c*ious". • In-depth post-vocalic /l/ and /r/ exercises • Pronunciation of country names worldwide • Word stress exercises for multi-syllabic words and word families **Pronunciation of individual vowels and consonants:** • Learn the International Phonetic Alphabet • Practice articulating both long and short vowels • Learn how to pronounce consonants in all environments: initial, medial, and final • Tongue twisters & articulation exercises • Breath exercises **Word stress patterns:** • Rules of both English and foreign-derived words • Dividing words into syllables • Syllable length • Stressed and unstressed syllables • Word form stress shift patterns • Nouns, adjectives & adverbs vs. verbs • Compound nouns **Activities** Pp 119, Unit-1, Pronunciation Exercise-10, track 005 Pp-121 Unit-2, Pronunciation Exercise -11,Track-008	**11**

	Pp-123, Unit-3, pronunciation Exercise-12 & 13,Track 011 & 012 (Text to be used: Mani, P. *English for Teaching.*)	
II	**SLRW Skill Enhancement** Character Description • Imagining Future • Cultural Differences • Alternative Beliefs • Media • Music & Films • Relationships • Science & Technology • Youth & Old Age • Tradition • Sports • Society (A list of words related to the themes can be provided as a supplement) **Activities** Odd man out vocabulary exercise Short text for dictation Dialogue for pronunciation & techniques Discuss questions Crossword clues with grid # 'Improve Your English- CD1' can be referred to prepare the above mentioned exercises.	**13**
III	**STRUCTURAL INPUT** Intonation, rhythm, and linking: • Neutral or "unmarked" patterns for statements and questions • Contrastive stress and usage • Content vs. function words • Rhythm and linking • Word clustering/grouping and Powerful Pauses **Activities** Exercises to be based on the following factors: Asking questions Using tags (isn't it? OK?) Using emphasis for effect Being polite Giving opinions Agreeing and disagreeing Complaining Small talk Using intonation to show emotion Using 'natural' English Pp-123, Unit-3, pronunciation, exercise-14,Track-013, Pp-128, unit-6, Pronunciation, Exercise- 8,Track-020 Pp-131, unit-8, pronunciation, Exercise-8,Track-024	**11**
IV	**SLRW Skill Enhancement** **Character Description** Social & Political issues Books Generation changes National traditions/customs & culture News (A list of words related to the themes can be provided as a supplement) **Activities** Odd man out vocabulary exercise Short text for dictation Dialogue for pronunciation & techniques	**9**

	Organizing Text Crossword clues with grid **Material to be used:** *'Accent'*, CD Available in 'Language Lab'. Raymond Murphy, *English Grammar in Use.* *Advanced Grammar Exercises* – TOEFL Practice Tests.	

Text book:

- Mani .P &Deepthi. S, "*English for Teaching",* CUP
- Murphy, Raymond, English Grammar in Use: "*A Self-study Reference and Practice Book*" (With Answers and CD ROM for Intermediate Students of English), Cambridge University Press.

Reference Books:

- Hornby,A.S., "*An Advanced Learners"* Dictionary of Current English, OUP.
- Murphy, Raymond, "*Intermediate English Grammar*", Cambridge University Press.

Material:

- *'Accent'*, CD Available in 'Language Lab' with other audio-video Material available in the language Lab.

MEE186: ENGINEERING DRAWING

Credits: 01 **Semester I/II** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**Introduction:** Introduction to drawing instruments, sheet layout, types of lines and their uses, lettering, types of dimensioning, application of symbols and conventions in drawing practice, geometrical construction. Concepts of scales in drawing and their types **Theory of projections:** Introduction of projections, Orthographic & Pictorial projection, **Orthographic projection:** Projection of points, lines, planes and solids. Section of solids, **Isometric projection:** Concepts of isometric and perspective views. Conversion of pictorial views to orthographic views and vice versa. Development of surfaces & Computer Aided Drawing using Auto CAD.	24

Text Books:

- Bhatt N.D., Panchal V.M., "*Elementary Engineering Drawing*", Charothar Publishing, Gujarat.
- Dhawan R.K.; "*A Text book of Engineering Drawing*", S. Chand.

Reference Books:

- Gopalkrishna K.R.; "*Engg. Graphics*"; Subhash Publishers, Bangalore.
- Trymbaka Murty. S; "*Computer Aided Engineering Drawing*"; T.K. International Publishing House Pvt. Ltd. New Delhi.
- Luzadder Warren J., Duff John M., "*Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production"*, Practice-Hall of India Pvt. Ltd, New Delhi.
- Singh Ajit, "*Machine Drawing"* Tata McGraw Hill, New Delhi.

Outcome:

- At the end of the course the student will be able to
- Use common drafting tools to construct engineering drawings and apply dimensions on engineering drawings. Create, construct and Interpret views and sectional views and projections. Create isometric and oblique sketches and identify standard features
- Use SI units, and standards scales to produce engineering drawings. Produce engineering drawings using computer aided drafting (CAD) system to improve visualization skills.

AHC181: ENGINEERING CHEMISTRY LAB

Credits: 01 **Semester I/II** **L–T–P: 0–0–2**

Any Twelve Experiments are to be performed

Module No.	Content	Lab Hours
I	• Preparation of standard solution of sodium hydroxide N/10 and standardize with the help of standard solution of oxalic acid. • To determine the strength of the given HCl solution using pH meter. • Determination of temporary and permanent hardness of water sample by complexometric method using EDTA as complexing agent. • Determination of constituents and amount of alkalinity in a given water sample. • To determine the chloride ion in the given water sample by Argentometric method (Mohr's method). • Determination of neutralization of a lubricant oils or Iodine number of unsaturated oil. • Determine of viscosity and surface tension of the given liquid. • Determination of rate constant for acid catalyzed hydrolysis of ethyl acetate through titration. • Determination of iron concentration in the sample of water by colorimetric method. The method involves the use if KCNS as color developing agent and the measurement are carried out at λ_{max} 480 nm. • To determine the ferrous ion content in the given iron ore by titrimetric analysis against standard K_2CrO_7 solution using $K_3[Fe(CN)_6]$ as external indicator. • Determination of moisture content in a given sample of coal. • To determine the free CO_2 in the given sample of water. • To find out the percentage of available chlorine in a given sample of bleaching powder by Iodometric method. • Show that inversion of cane sugar is the example of first order reaction by polari meter.	26

CSE182: PROBLEM SOLVING LAB

Credits: 01 **Semester II** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**Recursion** • WAP to calculate factorial of a number. • WAP to generate table of any number. • WAP to find GCD of two numbers. • WAP to calculate nth term of Fibonacci Series 1,1,2,3,5,8. • WAP to find the sum of digits of a number. • WAP to find the reverse of a string. **Structure** • WAP to enter 10 records of student. Structure fields are Name, Roll no, Marks. Calculate the average of their marks. • Declare a structure which will contain the following data for three employees. i. Emp_code 3 characters, ii. First_name 20 characters, iii. Middle_initial 1 character, iv. Last_name 20 characters. v. The employee code to be stored in the structure is E01, E02, E03. Write a program to input names for 3 employees and printout initials of each.(e.g. Anil K Nehra will be printed as AKN) along their codes. • WAP to demonstrate, how structure is passed to a function. • WAP to perform arithmetic operations using functions and switch case and enumeration. **Pointer** • WAP to display the contents of 2D array using pointer. • WAP to sort an array in ascending order using dynamic memory allocation and pointers. **File handling** • WAP to copy the contents of a given file into another file. • WAP to read the characters from a file and display the uppercase on a console. **Introduction to Data Structure** • WAP to demonstrate various operations (create, push, pop, overflow, underflow, peek, display) of STACK using array implementation. • WAP to demonstrate various operations (create, enqueue, dequeue, overflow, underflow, peek, display) of Queue using array implementation. • WAP to demonstrate various operations [(create, Traversing, Searching, Inserting an element (at beginning, at end, after a given element), Deleting an element (from beginning, from end, after a given element)] of a linked List. • WAP to demonstrate various operations (create, Traversing, Searching, Inserting an element at beginning, Deleting an element from end) of a doubly linked List.	24

MEE183: APPLIED MECHANICS LAB

Credits: 01 **Semester I/II** **L–T–P: 0–0–2**

Module No.	Content	Lab Hours
I	**List of Experiments** • Study of functioning of gear trains. • Deflection of simply supported beam and verification of theoretical values. • To determine the modulus of rigidity of rod with the help of torsion testing machine. • To study functioning of belt pulley systems. • To find the mechanical advantages, velocity ratio and efficiency of worm and worm wheel. • To find the coefficient of friction between the surface of a given wood slide bar and an inclined plane. • To find the coefficient of friction between belt and pulley using belt pulley system. • To find reaction at the supports of a simply supported beam with different types of loading. • To find moment of inertia of a fly wheel about the axis of rotation using electronic counter machine. • To find centre of gravity of different geometrical objects. • To find forces in members of a truss for different load conditions. • To study conversion of momentum. • To verify the law of conservation of energy. • To verify law of polygon of forces. • To verify law of parallelogram of forces. • Demonstration for centrifugal forces.	24

Outcome: At the end of the course the student will be able to

- Know the practical skills to analyze the forces, moments, and their equilibrium
- Know the practical skills to analyze the effect of friction
- Develop basic know how and awareness to deal with practical aspects of applied mechanics

AHM201: MATHEMATICS – III

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Solution of Cubic and Biquadratic Equations**: Cardon's Method of Solving Cubic Equations, Descartes' and Ferrari's Method of Solving Biquadratic Equations. **Fourier Series:** Fourier Series of Period 2_, Even and Odd Functions, Fourier Series for Discontinuous Functions, Half Range Sine and Cosine Series, Change of Interval.	13
II	**Fourier Transform:** Fourier Sine and Cosine Integrals, Complex Fourier Transform, Fourier Sine and Cosine Transforms, Applications to Heat Conduction Equations. **Z- Transform:** Properties of Z – Transform, Inverse Z – Transform, Partial Fractional and Residue Method, Applications of Z –Transform in Solving Difference Equations.	13
III	**Functions of A Complex Variable:** Analytic Functions, Cauchy-Reimann Equations, Harmonic Function, Milne's Thomson Method, Cauchy Integral Theorem, Taylor's, Maclaurin's and Laurent's Series (Without Proof), Zeros and Singularities, Residue, Cauchy Residue Theorem, Contour Integration Involving Unit Circle.	14

Reference Books:

- Kreyszig E., "*Advanced Engg. Mathematics*", 9th Ed., John Wiley & Sons.
- Peter V. O, Neil, "*Advanced Engg. Mathematics*", Thomson Learning.
- Greenberg M. D., "*Advanced Engineering Mathematics*", Pearson Education Inc.
- Bali & Goyal, "*A Text Book of Engg. Mathematics*", Infinity Science Press.
- Allen Jeffrey, "*Advanced Engineering Mathematics*", Academic Press, Elseveir.
- Ramanna B.V., "*Higher Engg. Mathematics*", TMH, New Delhi.

CEE201: ENVIRONMENTAL STUDIES

Credits: 02 **Semester III** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Basics of Environmental Studies: 7l** Environmental Studies: Introduction, Scope and Importance Environment: Concept, Natural and Anthropogenic Environment Natural Environment: Structure & Function of Atmosphere, Hydrosphere, Lithosphere and Biosphere Ecology and Ecosystem: Definitions Types, Structure & Functions of Ecosystem.	
II	**Natural Resources: 6l** Natural Resources: Introduction, Classification, Concept of Conservation Present Status and Major Issues Related to Water Resources, Forest Resources and Mineral Resources Energy Resources: Introduction, Classification, Energy Use Patterns, Energy Crisis, Alternative Energy Resources Present Status and Major Issues Related to Fossil Fuels, Hydroelectricity, Nuclear Energy, Solar Energy and Biomass Energy.	
III	**Current Environmental Problems: 7l** Effects of Human Activities on Environment: Effect of Agriculture, Housing, Mining, Transportation and Industries Environment Pollution: Causes, Effects and Control of Air Pollution, Water Pollution, Land Pollution and Noise Pollution Introduction and Management of Solid Wastes and Hazardous Wastes Global Environmental Challenges: Global Warming, Ozone Layer Depletion, Acid Rain, Urbanization, Overpopulation and Biodiversity Depletion.	
IV	**Environmental Protection: 6l** Environmental Protection: Role of Citizens, Role of Government, Initiatives by NGOs, Contribution of International Agencies and Conventions Approaches to Environmental Protection: Public Awareness, Environmental Education, Environmental Ethics, Environmental Laws and Environmental Economics Tools and Strategies: Environmental Impact Assessment, Life Cycle Assessment, Ecological Footprints and Sustainable Development Efforts Towards Environmental Protection in India.	

Reference Books:

- Joseph Benny, "*Environmental Studies*" Tata McGraw Hill Publications.
- Deswal & Deshwal, "*Textbook on Environmental Studies*" Dhanpat Rai & Sons.
- De A.K., "*Environmental Studies*" New Age International Publications.
- Singh Shashi K. and Singh Anisha, "*Environmental Science & Ecology*" A.B. Publications.
- Agarwal and Sangal, "*Environment & Ecology*" Khanna Prakashan Media (P) Ltd.

MEE201: FLUID MECHANICS

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Fluid and Continuum, Physical Properties of Fluids, Rheology of Fluids. **Dimensional Analysis and Hydraulic Similitude:** Dimensional Analysis, Buckingham's Pi Theorem, Important Dimensionless Numbers and Their Significance, Geometric, Kinematic and Dynamic Similarity, Model Studies. **Fluid Statics:** Pressure-Density-Height Relationship, Manometers, Pressure Transducers, Pressure on Plane and Curved Surfaces, Centre of Pressure, Buoyancy, Stability of Immersed and Floating Bodies.	12
II	**Kinematics of Fluid Flow:** Types of Fluid Flows: Continuum & Free Molecular Flows. Steady and Unsteady, Uniform and Non-Uniform, Laminar and Turbulent Flows, Rotational and Irrotational Flows, Compressible and Incompressible Flows, Subsonic, Sonic and Supersonic Flows, Sub-Critical, Critical and Supercritical Flows, One, Two and Three Dimensional Flows, Streamlines, Continuity Equation For 3D and 1D Flows, Circulation, Stream Function and Velocity Potential, Source, Sink, Doublet and Half-Body. **Dynamics of Fluid Flow:** Euler's Equation of Motion Along A Streamline and Its Integration, Bernoulli's Equation and Its Applications- Pitot Tube, Orifice Meter, Venturi Meter and Bend Meter, Hot-Wire Anemometer and LDA, Notches and Weirs, Momentum Equation and Its Application to Pipe Bends, Fluid Masses Subjected to Linear Acceleration and Uniform Rotation About An Axis.	14
III	**Laminar and Turbulent Flow:** Equation of Motion For Laminar Flow Through Pipes, Stoke's Law, Transition From Laminar to Turbulent Flow, Types of Turbulent Flow, Mixing Length Concept and Velocity Distribution in Turbulent Flow Over Smooth and Rough Surfaces, Resistance to Flow, Minor Losses, Pipe in Series and Parallel, Power Transmission Through A Pipe, Siphon, Water Hameer. **Boundary Layer Analysis:** Boundary Layer Thickness, Boundary Layer Over A Flat Plate, Laminar Boundary Layer, Application of Momentum Equation, Turbulent Boundary Layer, Laminar Sublayer, Separation and Its Control, Drag and Lift, Drag on A Sphere, A Two Dimensional Cylinder, and An Aerofoil, Magnus Effect, Kutta-Jonkowski Theorem.	13

Reference Books:

- Narasimhan S., "*First Course in Fluid Mechanics*", University Press.
- Som, S.K. & Biswas G., "*Introduction of fluid mechanics & Fluid Machines*", TMH, 2000, 2nd Edition.
- Das M. M., "*Fluid Mechanics & Turbomachines*", Oxford University Press
- Agarwal S.K. "*Fluid Mechanics & Machinery*", TMH
- Garde, R.J., "*Fluid Mechanics through Problems*", New Age International Pvt. Ltd, New Delhi, 2nd Edition.
- Hunter Rouse, "*Elementary Mechanics of Fluids*", John Wiley & Sons. OMC. 1946
- Shames, I.H., "*Mechanics of Fluids*", McGraw Hill, Int. Student, Education, 1988.
- Gupta Vijay and Gupta S.K., "*Fluid Mechanics and its Applications*", Wiley Eastern Ltd, 1984.
- Modi, P.N., and Seth, S.H., "*Hydrualics and Fluid Machines*", Standard Book House, 1989.
- Bansal R.K., "*Fluid Mechanics*", Laxmi Publications.
- Rajput R.K., "*Fluid Mechanics*" Laxmi Publications

MEE202: MATERIALS SCIENCE

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Historical Perspective, Importance & Requirement of Materials, Chemical Bondings. **Crystallography and Imperfections:** Concept of Unit Cell Space Lattice, Bravais-Lattices, Common Crystal Structures, Atomic Packing Factor and Density. Miller indices. X-Ray Crystallography Techniques. Imperfections, Dislocations in Solids. **Mechanical Properties and Testing:** Stress Strain Diagram, Ductile & Brittle Material, Stress Vs Strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testings Such As Strength Testings, Hardness Testings, Impact Testings, Fatigue Testing, Creep Testing, Non-Destructive Testings (NDT).	13
II	**Equilibrium Diagrams:** Types of Equilibrium-Diagrams: Solid-Solution Type, Eutectic Type and Combination Type. Iron-Carbon Equilibrium-Diagram and Its Importance. **Heat Treatment:** Various Types of Heat Treatment Such As Annealing, Normalizing, Quenching, Tempering and Case Hardening. Time Temperature Transformation (TTT) Diagrams. Cast Iron and Its Properties and Application, Various Types of Alloy Steels, Iron & Steel Making Furnaces	13
III	**Die-Electric Materials:** Die-Electric Materials and Its Uses. **Magnetic Materials:** Concept of Magnetism - DIA, Para, Ferro-Hysteresis. Soft and Hard Magnetic Materials, Magnetic Storages. **Semiconductors &Devices:** Energy Band Concept of Conductor, insulator and Semi-Conductor. Intrinsic & Extrinsic Semi-Conductors. **Super Conductivity & Superconductors:** Superconductivity and Its Applications. Meissner Effect. Type I & II Superconductors. Concept and Applications of Ceramics, Polymers, Composites, Metallic Form, Nano Materials and Smart Materials Etc.	15

Reference Books:

- Callister W.D., JR, "*Material Science & Engineering*", Addition-Wesley Publication.
- Gupta K.M., "*Materials Science*", Umesh Publication.
- Vlash Van, "*Elements of Material Science & Engineering*", John Wiley & Sons.
- Raghvan V., "*Material Science*", Prentice Hall.
- Narula, "*Material Science*", TMH.
- Srivastava, Srinivasan, "*Science of Materials Engineering*", New Age Publication.

MEE203: STRENGTH OF MATERIALS

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Stress, Strain and Strain Energy:** Simple and Complex Stresses and Strains, ***Thermal Stress*** Principal Stress and Strain. Mohr's Circle For 2-D Stresses; 3-D Stresses, Strains and Equilibrium Equations, Generalized Hooke's Law, Elastic Constants, Different Strain Energies, Theories of Failure, Castigliano's Theorem. **Simple Bending of Beams:** Pure Bending, Stresses in Beams Under Different Types of Loads, Flitched (Composite) Beams. **Slope and Deflection of Beams:** Slope and Deflection of Statically Determinate Beams Using Macaulay's Method, Area-Moment and Energy Methods, Statically Indeterminate Beams Under Different Types of Loads.	16
II	**Torsion:** Torsion of Circular Solid and Hollow Shafts. **Columns:** Euler's Theory of Buckling of A Column, Middle-Third and Middle-Quarter Rules, End Conditions For Columns, Different Empirical Formulae For Columns. **Springs:** Deflection of Helical Springs Under Different Types of Loads, Springs in Series and Parallel, Leaf Springs. **Pressure Vessels:** Stresses and Strains in Thin and Thick Cylinders and Spheres Subjected to Internal and External Pressures.	15
III	**Curved Beams:** Winkler-Bach Theory, Position of Neutral Axis For Rectangular, Trapezoidal and Circular Cross-Sections, Stresses in A Crane Hook. **Unsymeetrical Bending and Shear Centre:** Product Moment of Inertia, Slope of Neutral Axis, Stress and Deflection in Unsymeetrical Bending For Symeetrical Sections, Shear Centre For I-Section and Channel Section.	12

Reference Books:

- Ryder G.H., "*Strength of Materials*", MacMillan Publishers.
- Timoshenko and Young "*Strength of Materials*", Affiliated East-West.
- Singh Sadhu, "*Strength of Materials*" - Khanna Publications.
- Beer and Johnson, "*Mechanics of Material*", Mc Graw Hill Publication.
- Rajput R.K., "*Strength of Materials*", S. Chand & Company Ltd.
- Singer F.L. and Pytel, Harper "*Strength of Materials*" Row Publication.
- Shrinath L.S., "*Mechanics of Solids*", Tata Mc Graw Hill Publication.

EEE207: ELECTRICAL MACHINES AND AUTOMATIC CONTROL

Credits: 04 **Semester III** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Single Phase Transformer:** Review of 1-Phase Transformer& Auto Transformer Sumpner's Test. **Three Phase Transformer:** Three-Phase Transformer Connections, Conversion From 3-Phase To 2-Phase,Their Applications. **DC Motors:** Concept of Starting of DC Motors, Speed Control of DC Motors, Losses and Efficiency of DC Motors. **Servomotor:** DC and AC Servomotors, Their Applications. **Analogous System:** Linear Mechanical Elements, Force-Voltage and Force Current Analogy, Electrical Analogy of Simple Mechanical Systems, Concept of Transfer Function and Determination For Simple Systems.	13
II	**Three Phase Induction Motor:** Types, Equivalent Circuit, Torque Equation and Torque-Slip Characteristics of Three-Phase Induction Motors, Speed Control of Three-Phase Induction Motors. **Control System:** Open Loop and Closed Loop Controls, Servomechanisms, Concept of Various Types of Systems. **Signals:** Unit Step, Ramp Step, Unit Impulse and Periodic Signals With Their Mathematical Representations and Characteristics. **Process Control:** Introduction of P, PI, PID Controllers, Their Representations, Characteristics and Applications.	13
III	**Alternator:** Construction, Derivation of EMF Equation, Parallel Operation of Alternator. **Synchronous Motor:** Starting, Effects of Excitation of Synchronous Motors **Time Response Analysis:** Time Response of A Standard Second Order System, Response Specifications, Steady State Error and Error Constants **Frequency Response Analysis:** Correlation Between Time and Frequency Response of a Second Order System Bode Plot, Gain Margin & Phase Margin and Their Determination. **Stability:** Concepts of Types of Stability, Routh-Hurwitz Criterion and Its Application and Determination of Stability, Polar Plots, Introduction To Nyquist Stability Criterion, Root-Locus Techniques.	13

Text Book:

- Nagrath I. J. & Kothari D.P., "*Electrical Machines*", Tata McGraw Hill.
- Fitggerald A.E., Kingsley C. Jr. and Umans, "*Electric Machinery*", 6th Edition McGraw Hill, International Student Edition.
- Gupta B.R. & Singhal Vandana, "*Fundamentals of Electrical Machines*", New Age International.
- Bhimbra, P.S, "*Electric Machines*", Khanna Publishers.

Reference Books:

- Taub & Schilling, "*Digital Electronics*", Tata Mc Graw Hill.
- Maini Anil K., "*Digital Electronics: Principles and Integrated Circuits*", Wiley India Ltd, 2008.
- Millman, J. and Grabel A, "*Microelectronics*", Mc Graw Hill.
- Kumar Anand, "*Switching Theory and Logic Design*", Prentice Hall of India, 2008.
- Dutta Aloke. K., "*Semiconductor Devices and Circuits*", Oxford University Press, 2008.

MEE281: FLUID MECHANICS LAB

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**List of Experiments:** • To Determine Coefficient of Discharge of Given Shape of Orifice. • To Determine Coefficient of Discharge of Given Shape of Venturimeter. • To Demonstrate the Transition From Laminar to Turbulent Flow and to Determine Lower Critical Reynolds Number. • To Determine the Loss of Heads for Pipe Fittings. • To Determine Coefficient of Discharge of Given Shape of Mouth Piece. • To Determine the Meta Centric Height of the Given Ship Model Experimentally. • To Determine Coefficient of Discharge of A Given Shape of V- Notch. • To Verify Bernoulli's Theorem Experimentally. • To Study the Boundary Layer Velocity Profile Over A Flat Plate and to Determine the Boundary Layer Thickness. • To Verify Momentum Theorem Using Momentum Theorem Apparatus. • To Determine Coefficient of Discharge for Flow Over A Rectangular Weir. • To Determine the Friction Factor for Flow Through Pipes. • Measurement of Drag and Lift on Aerofoil In Wind Tunnel. • Virtual Demonstration of Velocity, Viscosity and Pressure Measuring Devices. • Demonstration of Open Circuit Wind Tunnel.	24

MEE282: MATERIAL SCIENCE AND TESTING LAB

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**List of Experiments** • To Prepare Specimen for Micro Structural Examination-Cutting, Grinding, Polishing, Etching. • To Study Crystal Structures and Crystals Imperfections Using Ball Models. • To Study Bravais Lattice With Help of Models. • To Determine the Grain Size of A Given Specimen. • Make A Comparative Study of Microstructures of Different Given Specimens after Micro Structural Examination (Mild Steel, Gray C.I., Brass, Copper Etc.) • Heat Treatment Experiments Such As Annealing, Normalizing, Quenching, Case Hardening and Comparison of Hardness before and After. • To Determine the Strength By Testing of A Given Mild Steel Specimen on UTM With Full Details and Plot on the Machine. • To Conduct Shear and Bend Tests on UTM. • To Conduct Impact Testing on Impact Testing Machine Like Charpy, Izod or Both. • To Conduct Hardness Testing of Given Specimen Using Rockwell and Vickers/Brinell Testing Machines. • To Calculate the Deflection of Beam and Young's Modulus of Elasticity of a Material of a Beam Simply Supported at the Ends. • To Conduct Torsion Testing of A Rod on Torsion Testing Machine. • To Determine the Spring Index Testing on Spring Testing Machine. • To Plot A Curve Between Strain Vs Time (E-T) for Creep Testing on Creep Testing Machine. • Study the Microstructure of Welded Component and HAZ (Heat Affected Zone) Macro and Micro Examination.	24

EEE287: ELECTRICAL MACHINES & AUTOMATIC CONTROL LAB

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	• To Obtain Magnetization Characteristics of A D.C. Shunt Generator. • To Obtain Load Characteristics of A Compound Generator (A) Cumulatively Compounded (B) Differentially Compounded. • To Obtain Load Characteristics of A D.C. Shunt Generator • To Obtain Efficiency of A Dc Shunt Machine Using Swinburne's Test. • To Perform Hopkinson's Test and Determine Losses and Efficiency of DC Machine. • To Obtain Speed-Torque Characteristics of A Dc Shunt Motor. • To Obtain Speed Control of Dc Shunt Motor Using (A) Armature Resistance Control • (B) Field Control • To Study Polarity and Ratio Test of Single Phase and 3-Phase Transformers. • To Obtain Efficiency and Voltage Regulation of A Single Phase Transformer by Sumpner's Test.	

AHE281: SOFT SKILLS-I

After Two Courses on Spoken English Namely Spoken English-1 & 2, This Course Focuses More on the Use of English, Specifically in Business Situations. the Course is Based on Diverse Range of Business Themes Which Help Students Visualize the Expectations From A Professional.

Course Objective:

Soft Skills-I Program Will Ensure That the Students Gain Confidence and Belief in What They Are Doing and Do Not Overly Doubt Themselves. Being Aware of Learning What They Need Both in and Out of the Classroom, They Will Acquire Clarity on what is Expected from Them.

Credits: 01 **Semester III** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	Who Am I and Why Am I Here, Change is the Only Constant, Learning To Learn, Technology Know–How for A Fresher, Knowledge On Tools, Application Orientation, Career Management (Journey and Options),	10
II	Business Communication, Service Mindset, Customer Mindset, Myths About Business, Values In Business, Business Etiquette, Email Etiquette, Telephone Etiquette, Team Building, Role of A Manager	10
III	Attitude for Success, Role Models, Handling Peer Competition, Building Relationships, Branding Yourself.	10

Reference Books:

- Cook S., "*The Effective Manager(e-book)*", IT Governance Publishing
- Lesikar, R. V., & Pettit J. B., "*Business Communication: Theory and Application*", All India Traveller Book Seller.
- Bhatnagar Nitin & Bhatnagar Mamta, "*Effective Communication and Soft Skills: Strategies for Success*", New Delhi, Pearson (Dorling Kindersley, India Ltd.)
- Mohan Krishan & Singh NP, "*Speaking English Effectively*", New Delhi: Macmillan Publishers India Ltd.
- Pillalamarri J. K., "*Management of Soft Skills Chennai*", Schitech Publications.
- Rao, M.S. & Ramana, P.S.V., "*Soft Skills for Better Employability*", ICFAI University Press.

AHM202: COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES

Credits: 04 **Semester IV** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Numerical Techniques I :** Solution of Algebraic & Transcendental Equations : Bisection, Regula - Falsi, Newton - Raphson Methods and Their Order of Convergence. Interpolation : Finite Differences, Relation Between Operators, Missing Term Technique, Newton Forward and Backward Difference Interpolation Formulae, Lagrange's Interpolation Formula, Newton's Divided Difference Formula.	13
II	**Numerical Techniques Ii** : Numerical Integration : Newton - Cote's Quadrature Formula, Trapezoidal Rule, Simpson's 1/3rd and 3/8th Rules, Boole's and Weddle's Rule. Numerical Solution of Ordinary Differential Equations : Single Step and Multi Step Methods, Picard's Method, Runge - Kutta Fourth Order Method, Milne's Predictor Corrector Method.	13
III	**Statistical Techniques :** Curve - Fitting: Method of Least Squares, Fitting of Straight Lines, Polynomials and Exponential Curves Etc. Correlation, Linear Regression Analysis, Binomial, Poisson and Normal Distributions, Statistical Quality Control Methods, X , R, P and Np Charts.	14

Reference Books:

- Iyenger, Jain, "*Numerical Methods for Scientific and Engg. Computation*", New Age International.
- S.S. Sastry, "*Introductory Methods of Numerical Analysis*", PHI.
- S. D. Conte and Carl de Boor, "*Elementary Numerical Analysis - an Algorithmic Approach*", TMH.
- M. Goyal, "*Numerical Methods and Statistical Techniques using C*", Firewall Media.
- S.P. Gupta, "*Statistical Methods*", S. Chand and Sons.

AHE201: ETHICS & VALUES

Credits: 02 **Semester IV** **L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	**Conceptual Foundations:** Foundations of Morality; Professional Ethics; Professional Standards in Engineering Practice; Major Theories of Ethics and Different Ethical Approaches; Normatively of Science and Technology **Professions and Moral Dilemmas:** Contemporary Ethical Issues; Conflict of Interests; Contracts; Rights and Violations; Consent and Dissent; Privacy and Confidentiality; Consultancy; Allocation of Burdens and Benefits; Direct and Indirect Responsibility; Patents, Piracy and Clones	14
II	**Decision Making :**Theoretical Bases; Foundational Values; Greater Welfare Approach; Risk-Benefit Analysis; Right-Based Approach; Priority Allocation; Binding Grounds of Decisions; Public Norms and Professional Guidelines	14
III	**Social Responsibility:** Individual and Collective Responsibility; Corporate Social Responsibility; Justice and Fairness; Beneficence and Safety; Respect for Humanity, Life, and Nature; Sustainable Development	11

MEE204: APPLIED THERMODYNAMICS

Credits: 04 **Semester IV** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Thermodynamics Relation:** Helmholtz and Gibbs Function, Maxwell Relation, Clapeyron Equation, Joule Thompson Coefficient and Inversion Curve, Coefficient of Volume Expansion, Adiabatic and Isothermal Compressibility. **Availability and Irreversibility:** Available and Unavailable Energy, Availability and Irreversibility, Second Law Efficiency. **Steam Generator:** Function of Boilers, Classification of Boilers, Modern Boilers, Working of Fire Tube and Water Tube Boiler, Mountings and Accessories, Draught and Its Calculation, Performance of Boilers.	13
II	**Condensers and Cooling Towers:** Function of Condenser, Condensing System, Surface and Jet Condensers, Mass of Circulating Water, Condenser and Vacuum Efficiency, Cooling Tower: Construction Details and Analysis. **Vapour Power Cycle:** Review of Carnot and Rankine Cycle, Effect of Operating Conditions on Thermal Efficiency of Rankine Cycle, Principle Methods of Increasing Thermal Efficiency, Deviation of Actual Cycle From Theoretical Cycle, Binary Vapour Cycle, Regenerative Feed Heating Cycles, Reheating and Regenerative Cycles.	12
III	**Flow Through Nozzles and Diffusers:** Classification of Nozzles and Diffusers. Steady Flow Energy Equation Through Nozzles, Momentum Equation. Nozzle and Diffuser Efficiencies, Mass Flow Rate Through Nozzle Under Isentropic Flow Condition, General Relationship, Between Area, Velocity and Pressure in Nozzles and Diffuser, Supersaturated Flow Through Nozzles, Effect of Variation of Back Pressure in Nozzle. **Steam Turbines:** Principles of Working of Steam Turbines, Classification & Comparison, Velocity Diagram For Impulse and Reaction Turbines. Staging, Stage and Overall Efficiency, Reheat Factor, Bleeding.	15

Reference Books:

- Kearton W.J., "*Theory of Steam Turbine*", Dhanpat Rai and Sons.
- Yadav R., "*Steam & Gas turbines and Power Plant Engineering*", VII ed., 2004, Central Publishing House Allahabad.
- Yahya S.M., "*Turbines, Compressors and Fans*", TMH Publication New Delhi.
- Nag P.K., "*Basic and Applied Thermodynamics*", TMH Publication New Delhi.
- Balani P.L., "*Thermal Engg*." Khanna Publishers.
- Rajput R.K., "*Thermal Engg*." Dhanpat Rai & Sons.

MEE205: MEASUREMENT AND METROLOGY

Credits: 04 **Semester IV** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Measurements:** General Concepts- Units and Standards – Measuring Instruments – Sensitivity, Readability, Accuracy and Precision, Static and Dynamic Response – Repeatability, Hysteresis – Systematic and Random Errors, Calibration. **Metrology and Inspection:** Standards of Linear Measurement, Line and End Standards, Limit, Fits and Tolerances. Interchangeability and Standardization. Measurement of Geometric Forms Like Straightness, Flatness, Roundness. **Sensors and Transducers:** Introduction to Sensors and Transducers.	16
II	**Measurement of Pressure:** Gravitational, Elastic and Indirect Type Pressure Transducers, Measurement of Very Low Pressures. **Strain Measurement:** Types of Strain Gauges and Their Working, Strain Gauge Circuits, Temperature Compensation, Strain Rosettes, Calibration. **Measurements of Force and Torque:** Introduction to Devices for Measuring Force and Torque. **Temperature Measurement:** Thermometers, Bimetallic Thermocouples, Thermistors and Pyrometers. **Vibration and Noise:** Seismic Instruments, Vibration Pick Ups and Decibel Meters, Vibrometers, Accelerometers.	15
III	Linear and Angular Measurements Devices, Sine Bar and System Comparators: Sigma, Johansson's Microkrator. **Interferometry:** Principle and Use of Interferometry, Optical Flat. Measurement of Screw Threads and Gears. **Surface Texture:** Surface Roughness, Quantitative Evaluation of Surface Roughness and Its Measurement. Limit Gauging, Limit Gauges Classification, Taylor's Principle of Gauge Design, Comparators.	10

Reference Books:

- Kumar D.S., "*Mechanical Measurements and Control*", Metropolitan, N. Delhi.
- Tayal A.K., "*Instrumentation and Mechanical Measurement*", Galgotia Publishers.
- Dobilin Ernest, "*Measurement Systems Application and Design*", TMH.
- Jain R.K., "*Measurement & Metrology*", Khanna Publications.

MEE206: MANUFACTURING SCIENCE – I

Credits: 04 **Semester IV** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Basic Concept:** Importance of Manufacturing, Classification of Manufacturing Processes and Its Applications. Elastic & Plastic Deformation, Yield Criteria. Concept of Inter-Facial Friction and Lubrication Mechanism in Manufacturing. Analysis and Estimation of Pressure Distribution and Die Load With Sliding and Sticking Friction During Forging for Strip and Disc (By Equilibrium Process). Analysis and Estimation of Pressure Distribution With Sliding Friction for Drawing and Extrusion of Wire/Strip. Maximum Reduction and Dead Zone Formation in Drawing Process. Conditions for Rolling, Force and Power in Rolling, Limiting Thickness and Reduction.	16
II	**Presses & Press Dies:** Power Presses, Types of Press Dies – Simple, Progressive, Compound and Combination. Punch & Die Clearance. Blanking & Piercing, Cutting and Punching Mechanism. Method of Reducing Cutting Forces. Bending of Strip & Spring Back. **Casting:** Pattern Design & Allowances. Gating, Riser, Runners, Core. Solidification of Casting. Sand Testing Methods. Cupola Furnace. Die Casting, Centrifugal Casting, Investment Casting, Carbon Di-Oxide Casting.	15
III	**Jigs & Fixtures:** Concept and Utility of Jig and Fixture. **Un-Conventional and Miscellaneous Metal Forming Processes:** Unconventional Metal Forming Processes- Explosive Forming, Electromagnetic Forming, Electro-Hydraulic Forming, Hydro-Static Extrusion, Hydro-Dynamic Wire Drawing, Their Applications, Advantages & Disadvantages. Concept and Applications of Powder Metallurgy and Plastic Processing.	10

Reference Books:

- Ghosh and Malik, "*Manufacturing science*", East West Pvt. Ltd.
- Boothroyd, "*Fundamental of Metal Cutting and Machine Tools*", John Wiley & Sons, Inc.
- Sharma P.C., "*Manfacturing Engineering*", S. Chand New Delhi
- Groover M.P., "*Manufacturing Process: Materials of Systems*", John Wiley & Sons, Inc.
- Ostwald Phillip F., "*Manufacturing Process*", John Wiley & Sons, Inc.
- Serope Kalpakjian**,** "*Manufacturing Process*", Addison Wesley Publishing Co.
- DeGarmo, "*Materials & Manufacturing*", Wiley Publications.

MEE207: KINEMATICS OF MACHINES

Credits: 04 **Semester IV** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Links-Types, Kinematics Pairs-Classification, Constraints-Types, Degree of Freedom, Grubler's Criterion, Kutzbach Equation, Linkage Mechanisms, Inversions of Four Bar Linkage, Slider Crank Chain and Double Slider Crank Chain. **Velocity in Mechanisms:** Velocity of Point in Mechanism, Relative Velocity Method, Instantaneous Point in Mechanism, Kennedy's Theorem, Instantaneous Center Method. **Acceleration in Mechanisms:** Acceleration Diagram, Coriolis Component of Acceleration, Klein's Construction for Slider Crank and Four Bar Mechanism, Analytic Method for Slider Crank Mechanism.	13
II	**Robotic Arm:** Basic Introduction to Kinematics of Robotic Arm. **Kinematics Synthesis of Planar Linkages:** Movability of Four Bar Linkages, Grashoff's Law, Graphical Methods of Synthesis – Two and Three Position Synthesis of Four Bar and Slider Crank Mechanisms, Analytical Method-Freudenstein's Equation for Function Generation (Three Position) **Mechanisms With Lower Pairs:** Pantograph, Exact Straight Line Motion Mechanisms - Peaucellier's, Hart and Scott Russell Mechanisms, Approximate Straight Line Motion Mechanisms – Grass-Hopper, Watt and Tchebicheff Mechanisms, Analysis of Hook's Joint, Davis and Ackermann Steering Gears.	15
III	**Cams:** Cams and Followers - Classification & Terminology, Cam Profile By Graphical Methods for Uniform Velocity, Simple Harmonic Motion, Cycloidal and Parabolic Motion of Followers, Analytical Cam Design – Tangent and Circular Cams. **Gears:** Classification & Terminology, Law of Gearing, Tooth Forms, Interference, Under Cutting, Minimum Number of Teeth on Gear and Pinion to Avoid Interference, Simple, Compound and Planetary Gear Trains.	16

Reference Books:

- Shingle, "*Theory of Machines and Mechanisms*", McGraw – Hill International Editions.
- Ghosh & Mallik, "*Theory of Machines and Mechanisms*", East west press.
- Rao & Dukkipati, "*Theory of Machines and Mechanisms*", East west press.
- Balani, "*Theory of machines & Mechanism*", John Wiley Publishers.
- Khurmi & Gupta, "*Theory of Machines*", S.Chand and Company Ltd.,. New Delhi.
- Bansal R.K., "*Theory of Machines*", Laxmi Publishers.
- Singh V. P. & Chand S., "*Theory of Machines*", Dhanpat Rai & Sons.

MEE285: MEASUREMENT AND METROLOGY LAB

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**List of Experiments:** • To Find Out the Error in the Shape of the Cube and Parallelism Among the Surfaces of the Cube Using Vernier Caliper. • To Analyzed the Deviation in Diameter of A Given Specimen Using Micrometer. • To Determine the Speed of A Motor Using Tachometer (Contact Device). • To Measure the Angle of A Given Specimen (Wooden Block) Using Sine Bar and Slip Gauges. • To Study the Limit Gauge For Better Understanding of Limits, Fits and Tolerances. • To Observe the Angular Measurements of A Given Specimen Using Bevel Protector. • To Measure and Adjust the Spark Plug Gap Using the Feeler Gauges. • To Perform Strain Measurement in Cantilever Beam Using Strain Gauge By Applying the Different Loads. • To Find Out the Circularity of A Cylindrical Rod Using Dial Gauge Indicator and V-Block. • To Find Out the Speed of Any Rotating Part (I.E., Ceiling Fan) Using Stroboscope (Non-Contact Device). • To Measure the Height of A Given Specimen Using Height Gauge. • To Determine the Temperature of A Heat Bath Using Resistance Type Detector (RTD) and Thermocouple. • To Measure the Linear Displacement Using Linear Variable Differential Transformer (LVDT). • To Measure the Pressure Using Bourdon Gauge and Strain Gauge. • To Determine the Torque of A Rotating Shaft Using Strain Gauge Coupled With Torque Sensor. • To Find Out the Flatness of A Surface Plate Using Spirit Level.	24

MEE286: MANUFACTURING SCIENCE - I LAB

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**List of Experiments -** • To Study and Analyze Different Types of Patterns Considering: (A) Shape (B) Size (C) Parting Line • To Design and Fabricate the Pattern for A Given Component Considering Different Allowances and Surfaces Which Require Machining. • To Make A Casting for Half Bush Gland By Self Hanging Core Mould as Per Given Dimensions. • To Make A Casting for Hollow Step Pulley With the Help of Green Sand Mould. • To Prepare the Bush Gland From Metal By Use of Dies Casting Method. • To Prepare A Bar of Circular Cross Section From Square Bar Keeping Length Constant. • To Prepare the Ring By Using the Bending and Forge Welding Operation. • To Make a Washer by Using Combination Die and to Study How Progressive Die is Different From Combination Die. • To Analyze the Flow Pattern During Tube Bending Process. • To Analyze the Flow Pattern and Die Load During Direct Extension Process By Using Dies of Different Shapes and Cross Section During: (A) Different Reduction Ratio (B) Different Shapes • To Make A 10 T.P.I. (R.H.) Thread on M.S. Bar for Hexagonal Bolt With the Help of Centre Lathe Machine as Per Given Figure. • To Make A Cast Iron Block and Make A Key Way on Its Surface With the Help of Shaper Machine as Per Given Figure. • To Make A Plain (Spur) Gear of 10 Teeth on Milling Machine as Per Given Figure. • To Make A Knurling Bush on Capstan Lathe as Per Given Dimensions and Sketch. • To Make A Single Point Cutting Tool Angles With the Help of Tool Grinding Machine A Per Given Dimensions and Sketch.	24

MEE288: MACHINE DRAWING LAB

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	**Orthographic Projections** (1 drawing sheet) Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views. **Screwed fasteners** (2 drawing sheet) Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangements of nuts, Foundation bolts. **Keys, Cotter Joint and Pin joint** (1 drawing sheet) Types of keys, Cotter joint or Knuckle joint. **Shaft Couplings** (1 drawing sheet) Rigid Coupling or Flexible coupling. **Riveted joints** (1 drawing sheet) Types of rivet heads, Types of riveted joints, Boiler joint. **Assembly Drawing** (1 drawing sheet) Engine parts-stuffing box, cross head, Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod safety valve etc. **Free hand sketching** (sketch sheet) Free hand sketching of foundation bolts, studs, pulleys, couplings, helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc. **Production Drawing** (2 drawing sheets) Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc. **Computer Aided Drafting** (2 drawings) Introduction, input, output devices, introduction to software like AutoCAD, Pro-E, basic commands and development of 2D and 3D drawings of simple parts.	24

AHE282: SOFT SKILLS-II

Introduction: This Course on Soft Skills Would Help the Students in Getting A Deeper Insight in Acquisition of Four Skills of LSRW. Various Activities and Exercises on Conversation, Discussion, Mini Presentations, Skimming, Scanning and Detailed Reading Etc. Will Provide the Students Enough of Opportunities & Exposure to Sharpen Their Soft Skills.

Objectives:

- To Make the Students Aware of the Primary Skills and Sub Skills Involved in Using English Effectively At the Contemporary Corporate Workplace With A Global Presence.
- To Provide Practice and Guidance to Enhance Skills to the Proficiency Level Expected by Any Organization.

Credits: 01 **Semester IV** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Introduction to English and Grammar. • Speaking Face to Face Vs. Over the Phone. • Auxiliary and Modal Verbs. • 4 Techniques of Reading- Skim, Scan, Intensive, Extensive. • ABC of Writing, the KISS Concept. • Presenting Ideas, Information and Opinions With Clarity. • Listening for Information and Making Inferences. • Intonation, Word Stress, Pacing, Sound Clarity	10
II	• Second Level of Reading to Interpret Information • Subject Verb Agreement • Understanding Ideas and Making Inferences • Indianism, Question Tags, Phrasal Verbs • Prepositions, Active and Passive Voice • Third Level Reading and Data Interpretation • Sentence Stress, Connected Speech • Tenses	10
III	• Adverbs, Adjectives, Modifiers, Collocation • Discussing Data and Coming to Conclusions • Link Expressions, Compound Nouns • Negotiation Skills • Business Quiz, Idioms and Phrases • Individual Presentation on Speaking and Writing • Feedback and Poster Creation	10

Reference Books:

- Hornby, A.S., "*An Advanced Learners*", Dictionary of Current English, OUP.
- Murphy, Raymond, "Intermediate English Grammar", Cambridge University Press.
- Rizvi, Ashraf, M., "Effective Technical Communication", Tata McGraw Hill, New Delhi
- Infosys modules on English lab.
- PPT slides & videos provided by Infosys.

Material:

- Audio-Video Material available in the language Lab.

MBA301: INDUSTRIAL ECONOMICS

Preamble: The Course of Industrial Economics Aims to Familiarize Students With The Basic Concepts of Economics Used in The Analysis of Firms and Industries and Act as A Guiding Tool in Decision Making With The Availability of Limited Resources in The Organization.

Objectives of the Course:

- To Familiarize Students With The Basic Concepts of Economics.
- To Enable The Students to Make Better Decisions in Their Course of Action.

UNIT – I	**Basic Economic Concepts:** Meaning, Nature and Scope of Economics, Methodology of Economics: - Deductive V/S Inductive, Economics - Statics & Dynamics, Basic Economic Problems: - Scarcity & Choice, Relation Between Science, Engineering, Technology and Economics.	**(3 Sessions)**
UNIT –II	**Market Demand** : Demand, Meaning and Types, Law of Demand, Exceptions to The Law of Demand, Elasticity of Demand, Methods of Measuring Elasticity of Demand, Marginal Utility Analysis.	**(4 Sessions)**
I Term Examination		
UNIT – III	**Demand Forecasting :**Meaning, Significance and Methods, Production Function, Laws of Returns to Scale & Diminishing Returns to Scale	**(3 Sessions)**
Unit – Iv	**Cost & Production Analysis**: - Production, Production Function, Short Run and Long Run Production Laws, Cost Concepts, Cost & Output Relationship.	**(4 Sessions)**
Ii Term Examination		
Unit – V	**Market Structure:** Meaning of Market, Types of Market- Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition	**(4 Sessions)**
Unit – Vi	**Inflation and Business Cycles**: Causes, Effects and Methods to Control Inflation, Concepts of Business Cycles, Concept of National Income and Measurement	**(3 Sessions)**
* **Provision for Presentations / Assignments / Case Analysis In Additional Sessions** ** **1 Session = 60 Minutes**		

Text Book:

- Dewett, K.K., (2005) "*Modern Economic Theory*", S. Chand, New Delhi.

Reference Books:

- Geetika G., Ghosh Piyali., & Choudhray Purba, (2008), "*Managerial Economics*", TMH.
- Dwivedi D, N. (2005), "*Managerial Economics*", New Delhi, Vikas Publishing House.
- Peterson Craig, Lewis H., Cris W. & Jain Sudhir K., (2008), "*Managerial Economics*" New Delhi, Pearson Education.

MBA303: PRINCIPLES OF MANAGEMENT

Preamble: Massive Industrialization and Rapid Changes in Business Environment in the Recent Past Has Created A Demand for Professionally Trained Managers With More Challenging and Demanding Roles to Be Played. Thus An Understanding of Management Principles and Practices is Extremely Required to Cope With the Dynamic Need of Present Complex Business Environment Which Requires High Degree of Creativeness and Innovativeness.

Objectives of the Course:

- The Course Aims At Giving An Introduction of the Basic Concepts, Principles and Practices of Management to the Students. A Comprehensive Understanding of These Principles Will Increase Their Decision Making Ability and Sharpen Their Tools for the Purpose. This Course Will Help the Students to Become More Sensible and Responsive to the Needs of Changing Environment

UNIT – I	**Management-** Concept & Nature, Management as A Science and Art, Role of Management Principles	**(3 Sessions)**
UNIT –II	**Principles of Management**- Henri Fayol & F.W.Taylor, Management Functions & Skills	**(3 Sessions)**
I TERM EXAMINATION		
UNIT – III	**Planning-** Steps and Types of Planning **Missions and Objectives**- Formulation of Mission and Objective Setting	**(4 Sessions)**
UNIT – IV	**Organizing -**Concept of Organization, Concept of Organization Structure, Concept of Authority and Responsibility, Essentials for Effective Coordination.	**(3 Sessions)**
II TERM EXAMINATION		
UNIT – V	**Staffing –** Concept of Staffing, Factors Affecting Staffing. **Directing-** Concept and Principles of Direction. Concept of Motivation and Leadership, **Communication-** Concept and Process.	**(4 Sessions)**
UNIT – VI	**Controlling-** Concept of Controlling, Steps in Controlling and Types of Control	**(3 Sessions)**
* **Provision for Presentations / Assignments / Case Analysis in Additional Sessions** ** **1 Session = 60 Minutes**		

Text Book:

- Prasad L.M., "*Principles & Practices of Management*", S. Chand & Sons, New Delhi.

Reference Books:

- Koontz, "*Principles of Management*", Tata McGraw Hill, 1stEdition 2008.
- Robbins & Caulter, "*Management*", Prentice Hall of India, 8thEdition.
- Parag Diwan, "*Management Principles and Practices*", Excel Books, New Delhi.
- Stoner, Freeman, Gilbert. Jr., "*Management*", Prentice Hall of India, 6thEdition.
- Koontz, Weihrich, "*Essentials of Management*", TMH, 5thEdition.

MEE301: MANUFACTURING SCIENCE – II

Credits: 04 **Semester V** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Metal Cutting:** Mechanics of Metal Cutting. Geometry of Tool and Nomenclature, ASA System. Orthogonal Vs Oblique Cutting. Mechanics of Chip Formation, Types of Chips. Shear Angle Relationship. Merchant's Force Circle Diagram. Cutting Forces, Power Required. Cutting Fluids/Lubricants. Tool Material. Tool Wear and Tool Life. Basic Idea of Machinability.	12
II	**Machine Tools:** Working Principle, Constructions and Operations of Turret and Capstan Lathe, Shaper, Planer, Slotter, Milling. Up Milling, Down Milling. Dividing Head and Types of Indexing and Tool Lay Out Turret and Capstan Lathe. **Grinding & Super-Finishing:** Grinding Wheel, Abrasive & Bonds. Grinding Wheel Specifications. . Grinding Wheel Wear, Attritions Wear & Fracture Wear. Dressing & Truing. Surface Grinding, Cylindrical Grinding & Center less Grinding. Honing, Lapping & Buffing.	14
III	**Metal Joining:** Resistance Welding, Seam Welding, Projection Welding. Atomic Hydrogen, Submerge Arc Welding, Friction Welding. Metallurgical Aspects in Welding. Defects in Welding and Remedies. **Un-Conventional Machining & Welding:** Working Principle & Applications of LBM, EBM & AGM. Working Principle & Applications of LBW, USW, EBW, Plasma-Arc Welding, Diffusion Welding, and Explosive Welding/Cladding.	14

Reference Books:

- Ghosh and Malik, "*Manufacturing science*", East West Pvt. Ltd.
- Boothroyd, "*Fundamental of Metal Cutting and Machine Tools*", S. Chand.
- Sharma, P.C., "*Manufacturing Technology (Manufacturing Processes)*", S. Chand.
- Jain V.K., "*Advance Machining Process*", Prentice Hall.

MEE302: MACHINE DESIGN – I

Credits: 04 **Semester V** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Definition, Design Requirements of Machine Elements, Design Procedure, Standards in Design, Selection of Preferred Sizes, Indian Standards Designation of Carbon & Alloy Steels, Selection of Materials for Static and Fatigue Loads. **Manufacturing Consideration in Design:** Statistical Considerations, Selective Assembly, Design Consideration in Machining, Castings, Forgings, Welding. **Design Against Static Load:** Modes of Failure, Factor of Safety, Principal Stresses, Stresses Due to Bending and Torsion, Theories of Failure. **Design Against Fluctuating Loads:** Cyclic Stresses, Fatigue and Endurance Limit, Stress Concentration Factor, Stress Concentration Factor for Various Machine Parts, Notch Sensitivity, Design for Finite and Infinite Life, Soderberg, Goodman Criteria.	14
II	**Design of Riveted Joints:** Types of Riveted Joints, Failure of Riveted Joint, Efficiency of Riveted Joint, Design of Boiler Joints, Eccentric Loaded Riveted Joint. **Design of Threaded Joint:** Design of Bolted Joint, Eccentrically Loaded Bolted Joint. **Design of Welded Joints-** Stresses in Butt and Fillet Welds, Eccentrically Loaded Joint. **Shafts:** Cause of Failure in Shafts, Materials for Shaft, Stresses in Shafts, Design of Shafts Subjected to Twisting Moment, Bending Moment and Combined Twisting and Bending Moments, Shafts Subjected to Fatigue Loads, Design for Rigidity.	14
III	**Keys and Couplings:** Types of Keys, Splines, Design of Square & Flat Keys, Couplings-Design of Rigid and Flexible Couplings. **Mechanical Springs:** Types, Material for Helical Springs, End Connections for Compression and Tension Helical Springs, Stresses and Deflection of Helical Springs of Circular Wire, Design of Helical Springs Subjected to Static and Fatigue Loading, Design of Leaf Spring. **Power Screws:** Forms of Threads, Multiple Threads, Efficiency of Square Threads, Trapezoidal Threads, Stresses in Screws, Design of Screw Jack. **Note: Design Data Book Is Allowed in the Examination**	12

Reference Books:

- Shigely Joseph E., "*Mechanical Engineering Design*", McGraw Hill Publications.
- Valance Alex and Doughtie VI, "*Design of Machine Members*", McGraw Hill Co.
- Spott M.F., "*Machine design*", Prentice Hall India.
- Maleev and Hartman, "*Machine Design*", CBS Publications.
- Black & Adams, "*Machine design*", Mc Graw Hill.
- Sharma and Agrawal, "*Machine Design*", S.K. Katara & Sons.
- Bhandari V.B., "*Design of Machine Elements*", Tata McGraw Hill Co.

MEE303: DYNAMICS OF MACHINES

Credits: 04 **Semester V** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Static & Dynamic Force Analysis:** Static Equilibrium of Two/Three Force Members, Static Equilibrium of Member With Two Forces and Torque, Static Force Analysis of Linkages, D'alembert's Principle, Equivalent Offset Inertia Force, Dynamic Force Analysis of Four Link Mechanism and Slider Crank Mechanism, Engine Force Analysis-Piston and Crank Effort. **Turning Moment & Flywheel:** Turning Moment on Crankshaft, Turning Moment Diagrams-Single Cylinder Double Acting Steam Engine, Four Stroke IC Engine and Multi-Cylinder Steam Engine, Fluctuation of Energy, Flywheel. **Balancing of Rotating and Reciprocating Masses:** Static and Dynamic Balancing, Balancing of Several Masses in the Same Plane and Different Planes, Balancing of Reciprocating Masses, Balancing of Primary Force in Reciprocating Engine, Partial Balancing of Two Cylinder Locomotives, Variation of Tractive Force, Swaying Couple, Hameer Blow.	15
II	**Governors:** Terminology, Centrifugal Governors-Watt Governor, Dead Weight Governors-Porter & Proell Governor, Spring Controlled Governor-Hartnell Governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of Governor, Controlling Force Diagrams for Porter Governor and Spring Controlled Governors. **Friction:** Pivots and Collar Friction-Uniform Pressure and Uniform Wear, Frictional, Centrifugal Clutches, Belt and Pulley Drive, Length of Open and Cross Belt Drive, Ratio of Driving Tensions for Flat Belt Drive, Centrifugal Tension, Condition for Maximum Power Transmission, V Belt Drive. **Brakes & Dynamometers:** Shoe Brake, Band Brake, Band and Block Brake, Absorption and Transmission Type Dynamometers.	13
III	**Gyroscopic Motion:** Gyroscopic Torque, Effect of Gyroscopic Couple on the Stability of Two Wheeler and Four Wheeler, Ships and Aero-Planes. **Mechanical Vibrations:** Types of Vibrations, Degrees of Freedom, Single Degree Free & Damped Vibrations, Forced Vibration of Single Degree System Under Harmonic Excitation, Critical Speeds of Shaft.	13

Reference Books:

- Rattan S.S., "*Theory of Machines*", TMH.
- Ballaney P.L., "*Theory of Machines*", Khanna Publication.
- Khurmi & Gupta, "*Theory of Machines*", S.Chand and Company Ltd.,. New Delhi.
- Bansal R.K., "*Theory of Machines*", Laxmi Publishers.
- Singh V. P. & Chand S., "*Theory of Machines*", Dhanpat Rai & Sons.
- Bevan Thomas, "*Theory of Machines*", CBS Publishers and Distributors.
- Shingle, "*Theory of Machines and Mechanisms*", McGraw – Hill International Editions.
- Ghosh & Mallik, "*Theory of Machines and Mechanisms*", East west press.
- Rao & Dukkipati, "*Theory of Machines and Mechanisms*", East west press.

MEE304: HEAT AND MASS TRANSFER

Credits: 04 **Semester V** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction to Heat Transfer:** Concepts of the Mechanisms of Heat Flows; Conduction, Convection and Radiation; Effect of Temperature on Thermal Conductivity of Materials; Introduction to Combined Heat Transfer Mechanism. **Conduction:** One-Dimensional General Differential Heat Conduction Equation in the Rectangular, Cylindrical and Spherical Coordinate Systems; Initial and Boundary Conditions. **Steady State One-Dimensional Heat Conduction:** Composite Systems in Rectangular, Cylindrical and Spherical Coordinates With and Without Energy Generation; Thermal Resistance Concept; Analogy Between Heat and Electricity Flow; Thermal Contact Resistance; Critical Thickness of Insulation. **Fins:** Heat Transfer From Extended Surfaces, Fins of Uniform Cross-Sectional Area. **Transient Conduction:** Transient Heat Conduction; Lumped Capacitance Method; Time Constant; Unsteady State Heat Conduction in One Dimension Only, Heisler Charts.	16
II	**Natural Convection:** Physical Mechanism of Natural Convection; Characteristic Length, Empirical Heat Transfer Relations for Natural Convection Over Vertical Planes and Cylinders, Horizontal Plates and Cylinders. **Forced Convection:** Basic Concepts; Hydrodynamic Boundary Layer; Thermal Boundary Layer; Flow Over A Flat Plate; Empirical Heat Transfer Relations; **Introduction to Mass Transfer:** Introduction; Fick's Law of Diffusion; Steady State Equimolar Counter Diffusion; Steady State Diffusion Though A Stagnant Gas Film, Different Dimensionless Number.	10
III	**Radiation:** Gray Body; Shape Factor; Black-Body Radiation; Radiation Exchange Between Diffuse Non Black Bodies in An Enclosure; Radiation Shields; Electrical Analogy of Radiation Heat Transfer; Solar Radiation. **Heat Exchanger:** Types of Heat Exchangers; Fouling Factors; Overall Heat Transfer Coefficient; Logarithmic Mean Temperature Difference (LMTD) Method; Effectiveness-NTU Method; Compact Heat Exchangers. **Condensation and Boiling:** Introduction to Condensation Phenomena; Drop wise Condensation; Heat Pipes; Boiling Modes, Pool Boiling;	14

Reference Books:

- Bayazitouglu & Ozisik, "*Elements of Heat transfer*", T.M.H.
- Holman J.P., "*Heat Transfer*", McGraw-Hill International edition.
- Pitts & Sisson, "*Schaum's outline of Heat Transfer*", McGraw-Hill International edition.
- Frank Kreith, "*Principles of Heat Transfer*", McGraw-Hill Book co.
- Welty, James R., "*Fundamentals of Momentum, Heat and Mass Transfer*", John Wiley
- Gupta, Vijay, "*Heat Transfer*", New Age International (P) Ltd. Publishers
- Rao Y.V.C., "*Heat Transfer*", University Press.
- Yadav R., "*Heat Transfer*", Central Publishing House, Allahabad.

MEE381: MANUFACTURING SCIENCE - II LAB

Credits: 01 **Semester V** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	• Design A Process Sheet Showing Machine Tool, Tool Layout, Operation Elements, Jig & Fixtures Used, Cutting Tool, Measuring Tool, Cutting Conditions for the Given Components as Shown in the Figure. • To Design A Layout of Foundry Shop to Produce/Manufacture Given Components. • Design A Drilling Jig for Drilling Four Holes on the Component as Shown in the Figure. • Design A Suitable Milling Fixture for the Component Shown in the Figure. • Design An Indexing Jig/Fixture for the Component Shown in the Figure. • Design & Draw A Press Tool to Produce the Component Shown in the Figure. • Design & Draw A Press Tool Set to Produce A Washer at Each Stroke of the Press. The Washer is Made of Mild Steel 2 Mm Thick and 20 Mm is Outside Diameter, Hole 8 Mm in Diameter. Assume Suitable Value of Shear Strength of Material. • Design A Twist Drill to Machine A Hole in Cast Iron Gear Housing. The Hole is 20 Mm in Diameter By 20 Mm Deep and is A Through Hole and the Machine Tool is A Vertical Drill Press. • Design the Gang Milling Arrangement of Cutters That You Would Provide for Machining of Faces Mark in Figure ▼▼ Material of the Component is the Cast Iron. Clearly Dimension Tooth Profile & Tolerances for Arbor, Cutter & Key. • Design A Circular Form Tool for the Component Shown in the Figure. Assume Suitable Data Wherever Necessary & Also Find the Tooth Profile. • The Cutting Force Components of A Tool Point While Machining on Mild Steel With A 10^0 Back Rake Angle High Speed Steel Tool is 105 Kg. If Feed is 0.06 Mm/Rev., Depth of Cut 2.2 Mm, Design A Suitable Cross Section of the Tool, Assuming the Shear Strength of the Tool Material to Be 20 Kg. /Mm^2 and A Factor of Safety is Approximately 2.5. The Young Module of the Tool Material is $20x10^3$ Kg. /Mm^2. If the Maximum Permissible Deflection is 0.04 Mm, Find the Extent By Which the Tool Can Be Projected Out of the Tool Post. Recommend Suitable Values of Tool Angles. Give A Neat Sketch of the Designed Tool.	

MEE 382: MACHINE DESIGN – I LAB

Credits: 01 **Semester V** **L–T–P: 0–0–3**

Module No.	Content	Teaching Hours
	List of Experiments **Students are Advised to Use Design Data Book For the Design. Drawing Shall be Made Wherever Necessary (Using CAD-Software Such as AutoCAD).** • Design & Drawing of Cotter Joint. • Design & Drawing of Knuckle Joint. • Design of Machine Components Subjected to Combined Steady and Variable Loads. • Design & Drawing of Eccentrically Loaded Riveted Joint. • Design & Drawing of Boiler Riveted Joint. • Design of Shaft for Combined Constant Twisting and Bending Loads. • Design of Shaft Subjected to Fluctuating Loads. • Design & Drawing of Flanged Type Rigid Coupling. • Design & Drawing of Flexible Coupling. • Design of Helical Spring. • Design of Leaf Spring. • Design of Helical Spring Subjected to Fluctuating Load . • Design of Screw Jack. • Design of Eccentrically Loaded Welded Joint. • Design of Eccentrically Loaded Threaded Joint.	

MEE383: THEORY OF MACHINES LAB

Credits: 01 **Semester V** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	List of Experiments • Study of Simple Linkage Models/Mechanisms and Verification of Grash off's Criteria of Four Bar Linkages. • Determination of Velocity Ratio and Verification of Holding torque in Epicyclic Gear Trains. • Determination of Natural Frequency in Longitudinal Vibrating System. • Determination of Natural Frequency in Transverse Vibration System. • Experimental investigation of the Characteristics of Dead Weight Mechanical Governor. • Experimental investigation of the Characteristics of Spring Controlled Governor. • Determination of Critical Speed in Whirling of Shafts. • Study of the Principles of Gyroscope and Verification of the Equation of Gyroscopic Couple. • Study of the Concept of Statics & Dynamic Balancing of Rotating Masses in Single and Multi Planes and Verification of Balancing Principles. • Measurement of Slip in Flat Belt under Different Belt Tensions and Varying Load Conditions. • Measurement of Slip in V Belt under Different Belt Tensions and Varying Load Conditions. • Measurement of Creep in Flat Belt. • Measurement of Creep in V Belt. • Development of Displacement Curves of Cam and Determination of Jumping Speeds. • Determination of Carioles Component of Acceleration Using Hydraulic Analogy.	

MEE384: HEAT AND MASS TRANSFER LAB

Credits: 01 **Semester V** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	List of Experiments • To Determine the Overall Heat Transfer Coefficient For A Composite Wall • To determine the thermal Conductivity of A Metallic Rod and Draw A Graph Between Variation in Conductivity and Temperature. • To Determine the Heat Transfer Rate Through the Composite Cylinder and the Overall Heat Transfer Coefficient of Composite System • To Determine the thermal Conductivity of Liquid • To Determine the thermal Contact Resistance of A Composite Wall • To Determine the Critical Thickness of insulation of A Lagged Pipe. • To Determine the Heat Transfer Through A Heat Pipe & Draw A Temperature Distribution Profile Under Steady State Condition • To Determine the Heat Transfer & Temperature Distribution Along A Uniform Cross- Section Fin Under Steady State in Free Convection. • To Determine the Heat Transfer & Temperature Distribution Along A Uniform Cross-Section Fin Under Steady State in Forced Convection. • To Determine the Specific Heat of Air under Specified atmospheric Conditions. • To Determine the Critical Heat Flux Through A Given Wire (Nichrome Wire) in A Pool Boiling Process. • To Determine the Heat Transfer & Overall Heat Transfer Coefficient in A Counter Flow & Parallel Flow Heat Exchanger. • To Determine the Stefan Boltzmann Constant Under Given Condition. • To Determine the Emissivity of A Test Plate. • To Determine the View Factor /Shape Factor of A Given Arrangement.	

AHE381: SOFT SKILLS-III

This Course Focuses on the Use of English, Specifically in Business Situations. The Course Is Based on Diverse Range of Business Themes Which Help Students Visualize the Expectations From A Professional.

Course Objective:

- Gain A Functional Understanding of Basic English Grammar
- Practice Language Skills to Eliminate Errors in Pronunciation and Sentence Construction
- Understand and Enhance interpersonal Communication Process

Credits: 01 **Semester V** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
I	• Business Communication Skills. • English Language Enhancement. • Verbs, Tenses, Phrasal Verbs • Synonyms, Antonyms and Homonyms. • Descriptive Words, Combining Sentences, Business Idioms. • Indianism in English, Frequently Mispronounced Words, Signposts in English. • The Art of Communication. • The Communication Process, Effective Listening, Non Verbal Communication.	10
II	• Intrapersonal & interpersonal Relationship Skills. • Self-Awareness, Self Esteem & Confidence, Assertiveness and Confidence. • Dealing With Emotions, The Team Concept, Elements of Teamwork, Stages of Team formation, What Is An Effective Team? • Essential Building Blocks of Effective Teams, Team Player Styles.	10

Reference Books:

- Cook, S., "*The Effective Manager (e-book)*", IT Governance Publishing.
- Lesikar, R. V., & Pettit J. B., "*Business Communication: Theory and Application*", All India Traveller Book Seller.
- Bhatnagar, Nitin & Mamta Bhatnagar, "*Effective Communication and Soft Skills: Strategies for Success*", Pearson (Dorling Kindersley, India Ltd.).
- Mohan, Krishan & NP Singh, "*Speaking English Effectively*", Macmillan Publishers India Ltd.
- Pillalamarri, J. K., "*Management of Soft Skills*" Schitech Publications.
- Rao, M.S. & Ramana, P.S.V., "*Soft Skills for Better Employability*", ICFAI University Press.

MBA302: INDUSTRIAL PSYCHOLOGY

Preamble: *Industrial* Psychology *is* Concerned with *the Study of Workplace Behavior. It is A Scientific Discipline and An Area of Professional Practice. As A Scientific Discipline, Industrial Psychology Critically Examines Workplace Behavior and Experience With A Goal to Understand What Influences People's Behavior on the Job, and What Consequences Their Job Behavior Has for Others Around Them and for the Organizations in Which They Work. Thus, Study of Industrial Psychology Provides Us A Comprehensive Insight for Understanding the Relationship Between Proper Application of Industrial Psychology Principles and Individual, Team, and Organizational Performance and Basic Assumptions About Human Nature.*

Objectives of the Course:

- The Course Aims At Giving An Introduction to the Work Place Psychology and the Factors That Affect It. This Will Help the Students to Manage Their Teams Efficiently and Effectively That in-Turn Result Into Increased Organizational Effectiveness.

UNIT – I	**Introduction to Industrial Psychology**: Definition, Brief History, Applications, Taylor's Scientific Management-Principles.	**(3 Sessions)**
UNIT –II	Time and Motion Study, Human Relations Approach – Hawthorne Experiments.	**(3 Sessions)**
I TERM EXAMINATION		
UNIT – III	**Individual At Work Place :** Definition & Theories of Motivation, Job Satisfaction	**(3 Sessions)**
UNIT – IV	**Stress:** Concept, Sources, Consequences and Management. **Organizational Culture :** Concept, Nature, Elements and Types	**(4 Sessions)**
II TERM EXAMINATION		
UNIT – V	**Leadership & Group Dynamics:** Definition, Types of Leaders, Styles of Leadership & Theories of Group Formation **Recruitment and Selection:** Methods of Recruitment, Steps in Selections Procedure	**(4 Sessions)**
UNIT – VI	**Performance Appraisal:** Meaning & Traditional Methods of Appraisal **Training and Development :** Concept & Methods of Training	**(3 Sessions)**
* **Provision for Presentations / Assignments / Case Analysis in Additional Sessions** ** **1 Session = 60 Minutes**		

Text Book:

- Michael G. Aamodt, "*Industrial/ Organizational Psychology*", Wadsworth, Cengage learning, 2001.

Reference Books:

- Blum M.L., and Naylor J.C., "*Industrial Psychology*", CBS Publishers & Distributors, 1984.
- Ronald Riggio, "*Introduction to Industrial/Organizational Psychology*", Pearson Education, International Edition 5th Edition, Oct 2008.

AHE301: TECHNICAL WRITING

The syllabus aims to develop the writing skills of students in order to equip them with techniques of writing messages formally. The learners will be trained to use various modes of written communication generally used to disseminate information within and outside an organization.

Credits: 03 **Semester V/VI** **L- T -P: 2-1-0**

Module No.	Content	Teaching Hours
I	**Vocabulary**: One Word Substitutions, Idioms & Phrases, Synonyms & Antonyms. **Correspondence Related To Meetings**: Agenda & Minutes of a Meeting. **Summarizing**: Précis Writing. **Technical Reports:** Objectives, Characteristics & Significance, Types, Structure & Format, Writing of Report.	**18**
II	**Business Letters**: Principles, Important Features & Structure, Types- Inquiry Letters, Quotation & Placing Orders, Claim & Complaint Letters, Sales & Credit Letters. **Official Correspondence**: Memos, Circular Letters, E-Mail, D.O. Letters. **Correspondence Related To Recruitment**: Job Application & Resume/Bio-Data.	**15**
III	**Technical Proposal:** Objectives, Characteristics & Significance. Types, Structure & Writing Of Proposals. **Study Skills**: Note Making & Note Taking. **Technical Articles:** Nature, Significance And Essentials, Journal Articles/ Research Papers.	**12**

Text Book:

- Rizvi, Ashraf (2005)," *Effective Technical Communication"*, Tata McGraw Hill, New Delhi.

Reference Books:

- Raman, Meenakshi; Sangeeta Sharma (2004), "*Technical Communication: Principles and Practice"*, Oxford University Press, New Delhi.

MEE305: MACHINE DESIGN II

Credits: 04 **Semester VI** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Spur Gears:** Tooth Forms, System of Gear Teeth, Contact Ratio, Standard Proportions of Gear Systems, Interference in volute Gears, Backlash, Selection of Gear Materials, Gear Manufacturing Methods, Design Considerations, Beam Strength of Gear Tooth, Dynamic Tooth Load, Wear Strength of Gear Tooth, Failure of Gear Tooth, Design of Spur Gears, AGMA and Indian Standards. **Helical Gears:** Terminology, Proportions for Helical Gears, Beam Strength and Wear Strength of Helical Gears, Herringbone Gears, Crossed Helical Gears, Design of Helical Gears. **Bevel Gears:** Types of Bevel Gears, Terminology, Gear Tooth Properties, Bevel Gear Mounting, Forces on Bevel Gears, Stresses in Bevel Gears, Bending Stress in Bevel Gears, Surface Stresses in Bevel Gears. **Worm Gears:** Types of Worms, Terminology, Gear Tooth Proportions, Efficiency of Worm Gears, Heat Dissipation in Worm Gearing, Strength and Wear Tooth Load for Worm Gears, Design of Worm Gearing.	16
II	**Sliding Contact Bearing:** Types, Selection of Bearing, Plain Journal Bearing, Hydrodynamic Lubrication, Properties and Materials, Lubricants and Lubrication, Hydrodynamic Journal Bearing, Heat Generation, Design of Journal Bearing, Thrust Bearing-Pivot and Collar Bearing, Hydrodynamic Thrust Bearing. **Rolling Contact Bearing:** Advantages and Disadvantages, Types of Ball Bearing, Thrust Ball Bearing, Types of Roller Bearing, Selection of Radial Ball Bearing, Bearing Life, Selection of Roller Bearings, Dynamic Equivalent Load for Roller Contact Bearing Under Constant and Variable Loading, Reliability of Bearing, Selection of Rolling Contact Bearing, Lubrication of Ball and Roller Bearing, Mounting of Bearing.	13
III	**IC Engine Parts:** Selection of Type of IC Engine, General Design Considerations, Design of Cylinder and Cylinder Head; Design of Piston, Piston Ring and Gudgeon Pin; Design of Connecting Rod; Design of Crankshafts.	11

Note: There will be Three Big Questions From Each Unit. Units I & II Each Consists of 40 Marks Whereas Unit III Consists of 20 Marks. Design Data Book is allowed in the Examination.

Reference Books:

- Shigely, Joseph E., "*Mechanical Engineering Design*", McGraw Hill Publications.
- Valance, Alex and Doughtie, VI, "*Design of Machine Members*", McGraw Hill Co.
- Spott, M.F., "*Machine Design*", Prentice Hall India.
- Maleev and Hartman, "*Machine Design*", CBS Publications.
- Black & Adams, "*Machine Design*", Mc Graw Hill.
- Sharma and Agrawal, "*Machine Design*", S.K. Katara & Sons.
- Bhandari, V.B., "*Design of Machine Elements*", Tata McGraw Hill Co.

MEE306: INDUSTRIAL ENGINEERING

Credits: 04 **Semester VI** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Concept, Scope, Objective, Functions, Techniques, & Role of Industrial Engineering. Meaning of Productivity, Difference Between Production & Productivity, Induces of Productivity, Reasons of Low Productivity, Techniques to Improve Productivity. Types of Production. Plant Location & Plant Lay Out. Basic Idea of Material Handling. **Time, Motion and Method Study:** Meaning & Benefit of Work Study, Time & Motion Study, Micro-Motion Study PMTS, Micro-Machining Diagrams, Flow Charts, Standard Time.	13
II	Method Study, Work Measurement, Works Sampling. Basic Concept of Ergonomics. **Production Planning & Control:** Introduction, Objectives, Phases and Factors of PPC, Its Functions & Effectiveness. Concept of Just in Time & Concept of Supply Chain Management. Inventory, Cost, Deterministic Models, Concepts of In deterministic Model.	13
III	**Management Economics:** Break Even Analysis and Margin of Safety, Fixed and Variable Costs, Concept of Value Analysis and Value Engineering. Depreciation and Its Causes, Obsolescence and Basic Ideas of Replacement, Concept and Utility of Maintenance. **Quality Control:** Process Control, SQC Charts, Single, Double and Sequential Acceptance Sampling.	14

Reference Books:

- Khanna O.P., "*Industrial Engineering & Management*", Dhanpat Rai & Sons.
- Shanker Ravi, "*Industrial Engineering*", Galgotia PVT Ltd.
- Koontz H. & Donnel C. O., "*Principle of Management & Analysis of Management Functions*", Tata McGraw Hill Co.
- Moore J., "*Manufacturing Management*", Prentice Hall Englewool cliffs: New Jersey.
- Telsang Martand, "*Industrial Engineering and Production Management*", S. Chand, New Delhi

MEE307: FLUID MACHINERY

Credits: 04 **Semester VI** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Classification of Fluid Machines & Devices, Application of Momentum and Momentum, Equation to Flow Through Hydraulic Machinery, Euler's Fundamental Equation. **Impact of Jet:** Introduction to Hydrodynamic Thrust of Jet on A Fixed and Moving Surface (Flat *&* Curve), Effect of Inclination of Jet With the Surface. **Hydraulic System:** Hydraulic Accumulator, Special Duty Pumps, Intensifier, Hydraulic Press, Lift and Cranes, Theory of Hydraulic Coupling and Torque Converters, Hydraulic Ram, Jet Pumps, Air Lift Pumps.	14
II	**Hydraulic Turbines:** Classification of Turbines, Impulse Turbines, Constructional Details, Velocity Triangles, Power and Efficiency Calculations. **Reaction Turbines:** Francis and Kaplan Turbines, Constructional Details, Velocity Triangles, Power and Efficiency Calculations, Degree of Reaction, Draft Tube, Cavitations in Turbines, Principles of Similarity, Unit and Specific Speed, Performance Characteristics, Selection of Water Turbines, Governing of Turbines.	14
III	**Centrifugal Pumps:** Classifications of Centrifugal Pumps, Vector Diagram, Work Done by Impellor, Efficiencies of Centrifugal Pumps, Specific Speed, Model Testing, Cavitations & Separation and Their Control, Performance Characteristics. **Positive Displacement Pumps:** Reciprocating Pump Theory, Slip and Coefficient of Discharges, Indicator Diagram, Effect and Acceleration, Work Saved by Fitting Air Vessels, Comparison of Centrifugal and Reciprocating Pumps, Positive Rotary Pumps, Gear Pump and Vane Pump, Performance Characteristics.	12

Reference Books:

- Lal, Jagdish, "*Hydraulic Machines*", Metropolitan Book Co. Pvt. Ltd.
- Vasandhani, V.P., "*Hydraulic Machines: Theory & Design*", Khanna Publishers
- Rajput, R K, "*Hydraulic Machines*", S. Chand & co Ltd.
- Addison, Thomas, "*Applied Hydraulics*", CBS Publishers
- Kumar, D. S., "*Hydraulic Machines*", Khanna Publishers

MEE308: INTERNAL COMBUSTION ENGINES

Credits: 04 **Semester VI** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction to I.C Engines and Working Cycles:** Engine Classifications, Review of Air Standard Cycles, Actual Cycle Analysis, Two and Four Stroke SI and CI Engines, Valve Timing Diagram for Two and Four Stroke Engine At Low and High Speed. **Fuels:** Important Qualities of SI and CI Engine Fuels, Rating of SI Engine and CI Engine Fuels, Dopes, Additives, Concept of Gaseous Fuels, Alternative Fuels and Bio Diesel, Emission Control Devices and Norms Like Euro and Bharat Norms. **Testing and Performance:** Calculation of Performance Parameters.	13
II	**SI Engines:** Combustion Details of SI Engine, Stages of Combustion, Flame Speed, Ignition Delay, Abnormal Combustion and Its Control, Types of Combustion Chamber, Carburetor, Fuel Injection System and Their Components, MPFI. **CI Engine:** Combustion Details of CI Engines, Stages of Combustion, Ignition Delay, Knock, Abnormal Combustion, Types of Combustion Chamber, Fuel Injection System of CI Engines and Their Components, Injection Timings.	14
III	**Gas Turbine and Jet Propulsion***:* Basic Concepts and Their Applications **Supercharging:** Types of Supercharging Methods, Supercharger and Turbocharger, Calculation of Supercharger. **Basic Concepts of Advanced Engines**:-Hybrid Engine, Rotary Engines, V-Engine. Concept of MV's (Multiple Valve's) , DOHC's, SOHC's, DTSI, Cam Less Engine, K-Series Engine, Iv-Tech Engine, Six Stroke Engine, Concept of Rotary and Reciprocating Compressors.	13

Reference Books:

- Gill, Smith & Ziurs, "*Fundamentals of Internal Combustion Engine*", Oxford & IBH Publishing Co.
- Rogowsky, "*IC Engines*", International Book Co.
- Mathur & Sharma, "*A Course in International Combustion Engines*", Dhanpat Rai & Sons.
- E.F Obert, "*I.C Engine Analysis & Practice*", S. Chand.
- Ganeshan, "*I.C Engine*", Tata Mc Graw Hill Publishers.
- R. Yadav, "*I.C Engine*", Central Publishing House, Allahabad.

MEE385: MACHINE DESIGN - II LAB

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	• Design of Spur Gear • Design of Helical Gear • Design of Bevel Gear • Design of Worm and Worm Gear • Design of Gear Assembly • Design of Project Report Consists of Different Types of Gears • Design of Antifriction Bearing Assembly • Design of Journal Bearing • Design of Project Report Consists of Different Types of Bearings. • Design of Cylinder and Cylinder Head. • Design of Piston, Piston Ring and Gudgeon Pin. • Design of Connecting Rod. • Design of Crankshafts. • The Design Project Consists of Two Imperial Size Sheets Drawn With 3D/2D CAD Software- One Involving Assembly Drawing With A Part List and Overall Dimensions and the Other Sheet Involving Drawings of Individual Components, Manufacturing Tolerances, Surface Finish Symbols and Geometric Tolerances Should be Specified So as to Make It Working Drawing. A Design Report Giving All Necessary Calculations of the Design of Components and Assembly Should Be Submitted. Students Are Required to be Submitted A Design Report Giving All Necessary Calculations of the Design of Components and Assembly. Develop the Programs in 'C' Language for All Design Components.	

MEE387: FLUID MACHINERY LAB

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	List of Experiments: • Demonstration of Working Principle of the Runner of Pelton Wheel, Francis Turbine and Kaplan Turbine. • To Find Efficiency and Performance Characteristics Curve of Pelton Turbine. • To Find Efficiency and Performance Characteristics Curve of Francis Turbine. • To Find Efficiency and Performance Characteristics Curve of Kaplan Turbine. • To Find the Performance Characteristics of A Centrifugal Pump and To Find Its Specific Speed and Efficiency. • To Find the Performance Characteristics of A Reciprocating Pump and to Find the Slip. • To Verify Momentum Equation Experimentally Through Impact of Jet Experiment. • To Create Hydraulic Jump and Verify Equation of Fluid Flow. • To Determine the Efficiency of Hydraulic Ram. • Demonstration of Any Water Pumping Station/Plant Through Detailed Visit. • Demonstration of Working Model of Hydraulic Lift. • Demonstration of Working Model of Hydraulic Brake. • To Design the Impeller of Centrifugal Pump Using Single Arc Method Through Auto Cad. • To Design the Casing of Impeller Pump Through Auto Cad. • To Investigate the Performance of A Gear Pump and to Plot the Characteristics.	

AHE382: SOFT SKILLS- IV

It is Well Recognized by the Industry That the Soft Skills Are Essential for Entry Level Employees Include: Articulation, Competence in Reading, Writing, Effective Listening and Oral Communication Skills; Adaptability to Cross Cultural Environment Through Creative Thinking and Problem Solving; Personal Management With Assertiveness and Initiative; Interpersonal Skills; The Ability to Work in Teams. Enterprises Define the Entrants to be 'Industry Ready' When They Possess These Soft Skills.

Course Objective:

- Understand What Constitutes A Professional Environment
- Develop Positive Group Strategies & Team Spirit
- Set Specific Measurable Goals for Themselves in Their Personal and/or Professional Life.
- Understand the Skills and the Intricacies Involved in Starting An Entrepreneurial Venture

Credits: 01 **Semester VI** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours (Approx.)
I	• Campus to Company • The Corporate Fit-Dressing and Grooming, Corporate Dressing – Dress for Success. • Business Etiquette. • Basic Table Manners. • Dealing With People. • Communication Media Etiquette. • Telephone Etiquette. • Email Etiquette.	10
II	• Group Discussions, Interviews and Presentations. • Group Discussions. • Group Discussions, Structured Group Discussions, Unstructured Group Discussions. • Interviewing Skills. • Interview Handling Skills. • An Effective Resume. • Resumes That Make An Impact – A Few Pointers. • The Interview Process. • The Interview Preparation Check List. • at the Interview – Putting Your Best Foot Forward. • Common Interview Mistakes. • Presentation Skills. • Voice, Body Language, Content and Visual Aids, Audience Management, Practice.	10
III	• Entrepreneurial Skills Development. • Goal Setting, Understanding Entrepreneurship. • Studying Entrepreneurial Competencies. • What Are the Entrepreneurial Competencies? • Entrepreneurship in Daily Life. • Venture Project Planning & Entrepreneurship Cycles. • Planning the Project. • Case Studies in Entrepreneurship. • Reference Books and Links. • Entrepreneurship Courses in India. • Links to Venture Capitalists. • Reference Books Used in This Manual.	10

Reference Books:

- Hornby, A. S., "*An Advanced Learners Dictionary Current English*" OUP.
- Murphy, Raymond, "*Intermediate English Grammar*", Cambridge University Press.
- Rizvi, Ashraf, M., "*Effective Technical Communication*", Tata McGraw Hill.
- Infosys modules
- PPT slides & videos provided by Infosys.

Material:

- Audio-Video Material available in the language Lab.

MEE401: COMPUTER AIDED MANUFACTURING

Credits: 04 **Semester VII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Automation** Introduction to CAM; Automated Manufacturing System; Need of Automation, Basic Elements of Automation, Levels of Automation, Automation Strategies, Advantages & Disadvantages of Automation, Historical Development and Future Trends. **Numerical Control** Fundamental of Numerical Control, Elements of NC Machine Tools, Classification of NC Machine Tools, Advantages, Suitability and Limitations of NC Machine Tools, Application of NC System, Methods for Improving Accuracy Considering the Factors Such as Tool Deflection and Chatter and Productivity. Tooling of NC Machines, Configuration of CNC, DNC and Adaptive Control. **NC Part Programming-** (A) Manual (Word Address Format) Programming. Examples Drilling, Turning and Milling; Canned Cycles, Subroutine, and Macro. (B) APT Programming. Geometry, Motion and Additional Statements, Macro-Statement.	17
II	**System Devices** Introduction to DC Motors, Stepping Motors, Feed Back Devices Such as Encoder, Counting Devices, Digital to Analog Converter and Vice Versa. **Interpolators** Digital Differential Integrator-Principle of Operation, Exponential Decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator. **Control of NC Systems** Open and Closed Loops. Control of Point to Point Systems- Incremental Open Loop Control, Incremental Close Loop, Absolute Close Loop; Control Loop in Contouring Systems. Computer Aided Inspection (CAI) and Computer Aided Testing (Cat).	11
III	**Computer Integrated Manufacturing System and Robotics** Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer Aided Process Planning-Retrieval and Generative, Concept of Mechatronics, Computer Aided Inspection. Types and Generations of Robots, Structure and Operation of Robot, Robot Applications. Economics, Robot Programming Methods. VAL and AML with Examples.	14

Reference Books:

- Groover Mikell P., "*Automation, Production Systems and Computer Integrated Manufacturing*", Prentice Hall Publishers.
- Kundra and Rao, "*Computer Aided Manufacturing*", TMH, New Delhi.
- Koren, "*Computer control of Manufacturing systems*", TMH, New Delhi.
- S.J. Martin, "*NC Machine Tools*", TMH, New Delhi.
- Koren, "*NC Machines*", TMH, New Delhi.
- Groover, "*CAD/CAM*", Prentice Hall Publishers.

MEE402: REFRIGERATION AND AIR CONDITIONING

Credits: 04 **Semester VII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Refrigeration** Introduction to Refrigeration & Methods of Refrigeration, Carnot Refrigeration Cycle and Its Limitations, C.O.P. **Refrigerants** Classification of Refrigerants, Nomenclature, Desirable Properties of Refrigerants, Secondary Refrigerants and CFC Free Refrigerants. Green House Effect. **Air Refrigeration Cycle** Open and Closed Air Refrigeration Cycles, Reversed Carnot Cycle, Bell Coleman or Reversed Joule Air Refrigeration Cycle, Aircraft Refrigeration System, Classification of Aircraft Refrigeration System. Boot Strap Refrigeration, Regenerative, Reduced Ambient, Dry Air Rated Temperature (DART). Elementary Knowledge of Refrigeration & Air Conditioning Equipments E.G., Compressors, Condensers, Evaporators & Expansion Devices.	13
II	**Vapour Compression System** Single Stage System, Analysis of Vapour Compression Cycle, Effect of Pressure, Sub Cooling & Superheating on C.O.P of the Cycle. Actual Vapour Compression Refrigeration Cycle. Multistage Vapour Compression System, Removal of Flash Gas, Intercooling, Different Multistage System, Cascade System. **Vapour Absorption System** Working Principle of Vapour Absorption Refrigeration System, Elementary Idea of Refrigerant- Absorbent Mixtures, Temperature – Concentration Diagram & Enthalpy – Concentration Diagram. Adiabatic Mixing of Two Streams, Ammonia – Water Vapour Absorption System, Lithium-Bromide Water Vapour Absorption System, Comparison.	13
III	**Air Conditioning** Introduction to Air Conditioning, Psychometric Properties and Their Definitions, Different Psychometric Processes, Thermal Analysis of Human Body, Effective Temperature and Comfort Chart, Cooling and Heating Load Calculations. Infiltration & Ventilation, Internal Heat Gain, Sensible Heat Factor (SHF), by Pass Factor, Grand Sensible Heat Factor (GSHF), Apparatus Dew Point (ADP). Elementary Knowledge of Transmission and Distribution of Air Through Ducts. **Refrigeration Equipment & Application** Air Washers, Food Preservation, Cold Storage, Refrigerator, Ice Plant, Water Coolers, Electrolux Refrigerator.	14

Reference Books:

- Prasad Manohar, "*Refrigeration and Air conditioning*", New Age International (P) Ltd. Pub.
- Arora C.P, "*Refrigeration and Air conditioning*", TMH.
- Arora & Domkundwar, "*Refrigeration and Air conditioning*", Dhanpat Rai & Co.
- Stoecker & Jones, "*Refrigeration and Air conditioning*", TMH.
- Roy J. Dossat, "*Refrigeration and Air conditioning*", Prentice Hall India.
- P.L. Baloney, "*Refrigeration and Air conditioning*", SNTI, Publications.
- Kuhen, Ramsey & Thelked, "*Thermal Environment Engg*", Central Book Agency.

MEE403: COMPUTER AIDED DESIGN

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Introduction to CAD/CAED/CAE, Elements of CAD, Essential Requirements of CAD, Concepts of Integrated CAD/CAM, Necessity & Its Importance, Engineering Applications Computer Graphics-I CAD/CAM Systems, Graphics Input Devices-Cursor Control Devices, Digitizers, Keyboard Terminals, Image Scanner, Speech Control Devices and Touch, Panels, Graphics Display Devices-Cathode Ray Tube, Random & Raster Scan Display, Color CRT Monitors, Direct View Storage Tubes, Flat Panel Display, Hard Copy Printers and Plotters. **Computer Graphics-II** Graphics Standards, Graphics Software, Software Configuration, Graphics Functions, Output Primitives- Bresenham's Line Drawing Algorithm and Bresenham's Circle Generating Algorithm. **Geometric Transformations:** World/Device Coordinate Representation, Windowing and Clipping, 2 D Geometric Transformations- Translation, Scaling, Shearing, Rotation & Reflection Matrix Representation, Composite Transformation, D Transformations, Multiple Transformation.	12
II	**Curves:** Curves Representation, Properties of Curve Design and Representation, Interpolation Vs Approximation, Parametric Representation of Analytic Curves, Parametric Continuity Conditions, Parametric Representation of Synthetic Curves-Hermite Cubic Splines-Blending Function Formulation and Its Properties, Bezier Curves-Blending Function Formulation and Its Properties, Composite Bezier Curves, B-Spline Curves and Its Properties, Periodic and Non-Periodic B-Spline Curves. **3D Graphics:** Polygon Surfaces-Polygon Mesh Representations, Quadric and Superquadric Surfaces and Blobby Objects; Solid Modeling-Solid Entities, Fundamentals of Solid Modeling-Set Theory, Regularized Set Operations; Half Spaces, Boundary Representation, Constructive Solid Geometry, Sweep Representation, Color Models. Application Commands for AutoCAD & Pro-E Software	12
III	**Numerical Methods With Programming in C/C++:** Introduction, Errors in Numbers, Binary Representation of Numbers, Root Finding- Bisection Method, Newton Raphson Method, Curve Fitting-Least Square Method, Numerical Differentiation-Newton's Interpolation, Numerical Integration-Trapezoidal and Simpson Method **Finite Element Method:** Introduction, Principles of Finite Elements Modeling, Stiffness Matrix/Displacement Matrix, Stiffness Matrix for Spring System, Bar & Beam Elements, Bar Elements in 2D Space (Truss Element). **Continuum Problems:** Classification of Differential Equations, Variational Formulation Approach, Ritz Method, Generalized Definition of An Element, Element Equations From Variations.	14

Reference Books:

- Hearn & Baker, "*Computer Graphics*", Prentice Hall of India.
- Saxena Anupam & Sahay B., "*Computer Aided Engineering Design*", Anamaya Publishers.
- Groover HP & Zimeers EW, Jr. "*CAD/CAM*", Prentice Hall India Ltd.
- Zeid Ibrahim & Sivasubramaniam R, "*CAD/CAM Theory and Practice*", McGraw Hill.
- Srivastava RK, "*Computer Aided Design*", Umesh Publications.

MEE481: CAD/CAM LAB

Credits: 01 **Semester VII** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	Total TEN Experiments are to Carry Out. FIVE Experiments Each From CAD and CAM. **A. CAD Experiments** • Line Drawing or Circle Drawing Experiment: Writing and Validation of Computer Program. • Geometric Transformation Algorithm Experiment for Translation/ Rotation/ Scaling: Writing and Validation of Computer Program. • Design of Machine Component or Other System Experiment: Writing and Validation of Computer Program. • Understanding and Use of Any 3-D Modeling Software Commands. • Pro/E/Idea Etc. Experiment: Solid Modeling of A Machine Component • Writing A Small Program for FEM for 2 Spring System and Validation of Program or Using A Fem Package. • Root Findings or Curve Fitting Experiment: Writing and Validation of Computer Program. • Numerical Differentiation or Numerical Integration Experiment: Writing and Validation of Computer Program. **B. CAM Experiments** • To Study the Characteristic Features of CNC Machine. • Part Programming (in Word Address Format) Experiment for Turning. Operation (Including Operations Such as Grooving and Threading) and Running on CNC Machine. • Part Programming (in Word Address Format or ATP) Experiment for Drilling Operation (Point to Point) and Running on CNC Machine. • Part Programming (in Word Address Format or ATP) Experiment for Milling Operation (Contouring) and Running on CNC Machine. • Experiment on Robot and Programs. • Experiment on Transfer Line/Material Handling. • Experiment on Difference between Ordinary and NC Machine, Study or Retrofitting. • Experiment on Study of System Devices Such as Motors and Feed Back Devices. • Experiment on Mecatronics and Controls.	

MEE482: REFRIGERATION AND AIR-CONDITIONING LAB

Credits: 01 **Semester VII** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	List of Experiments: • Experiment on Refrigeration Test Rig and Calculation of Various Performance Parameters. • To Study Different Types of Expansion Devices Used in Refrigeration System. • To Study Different Types of Evaporators Used in Refrigeration Systems. • To Study Basic Components of Air-Conditioning System. • Experiment on Air-Conditioning Test Rig & Calculation of Various Performance Parameters. • To Study Air Washers. • Study of Window Type Air Conditioner. • Study & Determination of Volumetric Efficiency of Compressor. • Visit of A Central Air Conditioning Plant and Its Detailed Study. • Visit of Cold-Storage and Its Detailed Study. • Experiment on Ice-Plant to Find Out the Capacity of Plant. • Experiment on Two Stage Reciprocating Compressor for Determination of Volumetric Efficiency, PV Diagram and Effect of Intercooling. • Study of Compressors - Hermetically Sealed. • Experiment on Desert Coolers. • Study of Central Air-Conditioning Systems	

MEE404: AUTOMOBILE ENGINEERING

Credits: 04 **Semester VIII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Power Unit:** Power and Torque Characteristics, Rolling Resistance, Air Resistance, Gradient Resistance, Tractive Effort on Power of Automobile, Concept of Gear Ratio, Gear Box and Their Types, Selector Mechanism of Gear Box **Transmission System:** Requirements of Good Transmission Systems, Clutches and Their Types, Over Drive and Free Wheel, Torque Converters Differential Gear Mechanism, Automatic Transmission and Its Components, Propeller Shaft, Slip Joints, Universal Coupling, Final Drive and Their Types	12
II	**Steering System :** Types of Steering Mechanism, Front Axle, Castor, Camber, Toe-in, Toe-Out, Under seer, Overseer, Working of Power Steering **Braking System:** Requirement of Breaking System, Various Types of Braking System, Anti Locking Braking System, EBD (Electronic Breaking Force Distribution) **Chassis and Suspension System:** Frame and Their Types, Load on Frame, Shock Absorbers, Various Types of Suspension Springs Types of Front Axle Independent Suspension System.	15
III	**Electrical System:** Types of Ignition System Used in Automobiles and Their Working, Alternator, Battery, Starting Motor, Lighting System, Horn, Windscreen Wiper, Speedometer Etc. **Cooling & Lubrication System:** Requirements, Various Components, Types of Cooling and Lubrication Systems, Heating and Cooling Unit of Automobiles **Maintenance System:** Preventive Maintenance, Breakdown Maintenance, Overhauling Technical Specification of Various Cars: Honda City, Hyundai Verna, Chevrolet Cruze, Toyota Fortuner, Honda CRV, Hyundai Santa Fe.	12

Reference Books:

- Ttti, Jain K.K., Asthana R.B., "*Automotive Engineering*" TMH.
- Singh Kripal, "*Automobile Engineering*", Standard Publisher New Delhi, Vol. 1 & Vol. 2
- Narang, "*Automobile Engineering*", S.Chand Publications, New Delhi.
- Newton and Steeds, Joseph Heither, "*Automotive Mechanics*", C.B.S., Publisher & Distributors.
- "*Automotive Mechanics- Crouse*" – Mc. Graw Hill, 10th Edition, New York.

MEE405: OPERATIONS RESEARCH

Credits: 04 **Semester VIII** **L–T–P: 3–1–0**

Module No.	Content	Teaching Hours
I	**Introduction:** Basics of Operations Research, Application Area, Models, Advantages and Disadvantages of Operations Research. **Linear Programming:** Introduction & Scope, Problem Formulation, Graphical Method, Simplex Method, Duality in Linear Programming, Artificial Variable Method, Degeneracy. **Assignment Problems:** Mathematical Formulation, Hungarian Method for Minimization and Maximization Problem, Degeneracy in Assignment Problem **Transportation:** Matrix Form, Feasible Solution, Basic Feasible Solution and Optimum Solution, Degeneracy in Transportation, Unbalanced-Problems, Travelling Salesman Problem, Redundancy.	13
II	**Dynamic Programming:** Multistage Decision Problems & Solutions, Principle of Optimality. **Decision Theory** Steps in Decision Making Approach, Decision Making Under Conditions of Certainty, Uncertainty & Risk, Maximum Likelihood & Expected Value Criterion, Decision Tree. **Game Theory:** Two Persons Zero Sum Game, Solution With/Without Saddle Point, Dominance Rule, Different Methods Like Algebraic, Graphical, Linear Programming Methods. Approximation Method for Solution of Game. **Sequencing Problem:** Introduction, Assumption, Johnson's Procedure for N Jobs on Two Machines and N Jobs on Three Machines.	13
III	**Stochastic Inventory Models:** Single & Multi Period Models With Continuous & Discrete Demands, Service Level & Re-Order Policy. **Simulations:** Simulation V/S Mathematical Modeling, Monte-Carlo Simulation, Simulation Languages, Uses, Advantages and Limitations. **Queuing Models**: Introduction, Poisson Distribution, Exponential Distribution, Characteristics of Queuing Models, Single Server and Multiple Servers Models, Cost Consideration. **Project Management** Basic Concepts, Rules for Network Drawing, CPM Calculations, Pert Calculations Such As Different Times and Different Floats, Crashing, Probabilistic Model.	14

Reference Books:

- Wagner, Claire, "*Principles of Operations Research*", Prentice Hall International Publications.
- Buffa, Edwood, "*Production Planning of Operation Management*", TMH Publications.
- Rao, S.S. "*Optimization Techniques*", Wiley Eastern Limited.
- Gupta Prem Kumar, Hira D.S., "*Operations Research*", S. Chand & Co.
- Taha, Hamdy A., "*Operations Research*", Prentice Hall International Publications.

MEE484: AUTOMOBILE ENGINEERING LAB

Credits: 01 **Semester VIII** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	List of Experiments: • Performance Analysis of Four Stroke S.I. Engine- Determination of Indicated and Brake Thermal Efficiency, Specific Fuel Consumption At Different Loads, and Preparation of Energy Balance Sheet. • Determination of Indicated H.P. of I.C. Engine by Morse Test. • Performance Analysis of Four Stroke C.I. Engine- Determination of Indicated and Brake Thermal Efficiency, Specific Fuel Consumption At Different Loads, and Prepare Energy Balance Sheet. • To Study the Working Principle of Gear Boxes. • Trouble Shooting on Differential Gear Mechanism of Rear Axle. • Measurement of Steering Geometry Angles and Their Impact on Vehicle Performance.. • Trouble Shooting on Automobile Braking System. • Study of Chassis and Suspension System. • Trouble Shooting on Ignition System of I.C. Engine. • Trouble Shooting on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI. • Trouble Shooting on Fuel Supply System of C.I. Engines- Injector & Fuel Pump. • Study of Air Conditioning System of An Automobile. • Comparative Study of Technical Specifications of Common Small Cars (Such As Maruti Swift, Hyundai I20, Cheverlet Aveo, Tata Indica, Ford Fusion Etc. • Comparative Study & Technical Features of Common Scooters & Motorcycles Available in India. • Engine Tuning of Maruti 800 Car. • To Analyze Exhaust Gas Emission of An I.C. Engine.	

MEE487: ADVANCED SOFTWARE LAB

Credits: 01 **Semester VIII** **L–T–P: 0–0–2**

Module No.	Content	Teaching Hours
	• Use of Pro/Engineer and Pro/Mechanical Software for Exercises in: Design and Analysis of Mechanical Component Design Studied in Subjects of MD-I and MD-II. • Optimization of Mechanical Design of Components and Assemblies. • Reverse Engineering Tools and Their Use in Component Design. • Design Automation and User Defined Features, Advanced Assembly. • Structural, Welding, Surfacing, Behavior Modeler and Other Advanced Modules Use and Demonstration of Case Studies. • Application of Finite Element Methods to Elasticity Problems and Heat Transfer Problems. Using ANSYS, HYPERMESH, and FEM Software's.	

ELECTIVE-I
MEE461: COMPUTATIONAL FLUID DYNAMICS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** What is CFD, How Does A CFD Code Work, and Problem Solving With CFD. **Conservation Laws of Fluid Motion and Boundary Conditions:** Governing Equations of Fluid Flow, Equation of State, Navier – Stokes Equations for A Newtonian Fluid, Conservative Form of the Governing Equations for Fluid Flow, Differential and Integral Forms of the General Transport Equation, Classification of Physical Behavior, The Role of Characteristics in Hyperbolic Equations, Classification Method for Simple Partial Differential Equation, Classification of Fluid Flow Equations, Auxiliary Conditions for Viscous Fluid Flow Equation. **Turbulence and Its Modeling:** What is Turbulence, Transition From Laminar to Turbulent Flow, Effect of Turbulence on Time – Averaged Navier – Stokes Equations, Characteristics of Simple Turbulent Flows, Turbulence Models Such as Mixing Length Model, The K –Ɛ Model, Reynolds Stress Equation Models?	15
II	**The Finite Volume Method for Diffusion Problem:** Introduction, Finite Volume Method for Steady State Diffusion, Worked Examples: One Dimensional Steady State Diffusion, Finite Volume Method for Two Dimensional Diffusion Problem, Finite Volume Method for Three Dimensional Diffusion Problem **The Finite Volume Method for Convection – Diffusion Problem:** Introduction, Steady One Dimensional Convection and Diffusion, The Central Differencing Scheme, Properties of Discretisation Scheme, The Upwind Differencing Scheme, The Hybrid Differencing Scheme, The Power – Law Scheme, Higher Order Differencing Schemes for Convection – Diffusion Problems: OUICK Scheme.	12
III	**Solution Algorithms for Pressure Velocity Coupling in Steady Flows:** Introduction, The Staggered Grid, The Momentum Equations, The SIMPLE Algorithms, The SIMPLER Algorithms, The SIMPLEC Algorithms, The PISO Algorithms, General Comeents on SIMPLE, SIMPLER, SIMPLEC and PISO. **Solution of Discretised Equations:** Introduction, The Tri – Diagonal Matrix Algorithms, Application of TDMA to Two Dimensional Problems, Application of TDMA to Three Dimensional Problems.	13

Reference Books:

- Anderson J., "*Computational Fluid Dynamics An Introduction*", III Edition, Springer, 2009.
- Zikonav Oleg, "*Essential Computational Fluid Dynamics*", John Wiley & Sons, 2010.
- Blazek J., "*Computational Fluid Dynamics: Principles and Applications*", II Edition, 2009, Elsevier Ltd.

ELECTIVE-I
MEE462: PRODUCT DEVLOPMENT & DESIGN

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Product Design:** Introduction to PDD, Applications, Need Analysis and Need Identification. Relevance, Product Definition, Scope, Terminology. Design Definitions, The Role and Nature of Design, Old and New Design Methods, Design by Evolution. , Design by Craft, Need Based Development, Technology Based Developments & Economic Feasibility of Design Concepts, Product Classification. **Morphology of Design:** Divergent, Transformation and Convergent Phases of Product Design. Identification of Need, Analysis of Need. Design for What? Design Criteria, Functional Aspects. Aesthetics, Ergonomics, Form (Structure). Shape, Size, Color. Mental Blocks, Removal of Blocks, Ideation Techniques.	14
II	**Reliability:** Reliability Considerations: Reliability Analysis of Systems, Bath Tub Curve, Reliability of Systems in Series and Parallel. Failure Rate, Mean Time to Failure (MTTF) and Mean Time Between Failures (MTBF). **Decision Theory:** Decision Making Under Conditions of Certainty, Decision Making Under Conditions of Uncertainty, Decision Making Under Conditions of Risk, Maximum Likelihood Criterion, Variation of Expected Value Criterion. **Break-Even Analysis:** Fixed and Variable Costs, Assumptions of Break Even Analysis, Utility of Break Even Analysis, Limitation of Break Even Analysis.	14
III	**Work-Study: Components:** of Work Study, Tools of Method Analysis Such as Flow Process Chart and Flow Diagram, Time Study, Work Sampling. **Statistical Quality Control (SQC):** Advantages of Statistical Quality Control, Quality Control Charts, Types of Control Charts Such as X(Bar) and R Chart, P Chart and C Chart. **Technological Forecasting**: Characteristics and Importance of Technological Forecasting, Different Forecasting Methods.	12

Reference Books:

- Ulrich K. T, and Eppinger S.D, "*Product Design and Development*", Tata McGraw Hill
- Chitab A.K. & Gupta R.C., "*Product Design & Manufacturing*", PHI (EEE).
- Starr M.K., "*Product Design & Decision Theory*", Prentice Hall.
- Cain C .D, "*Engineering Product Design*", Business Books.
- Mayall W .H. Itiffe, "*Industrial Design for Engineers*", TMH.
- J. Christopher Jones, "*Design Methods – seeds of human futures*", John Wiley & Sons.

ELECTIVE-I
MEE463: MICRO MANUFACTURING

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction** Micro Manufacturing: An Introduction, Challenges in Meso-, Micro-, and Nano-Manufacturing, Materials and Their Properties for Micro manufacturing. **Micromachining:** Micro-Turning, Micro-Grinding, Bio-Machining, Genus-Based Metal Removal, Micro- and Nano Manufacturing by Focused Ion Beam.	12
II	**Micro Joining** Laser Micro-Welding, Electron Beams for Macro- and Micro-Welding Applications. **Micro Forming** Micro- and Nanostructured Surface Development by Nano Plastic Forming and Roller Imprinting, Microextrusion, Microbending With Laser, Micro-Fabrication Processes in Semiconductor Industry. **Micro Molding** A Soft Lithography Technique, Polymer Micro-Molding, Metal Injection Molding At Micro-Scales	14
III	Dimensional Metrology for Micro/Mesoscale Manufacturing, Fabrication of Microelectronic Devices, An Integrated Wafer Surface Evolution Model for Chemical Mechanical Planarization (CMP), Nanofinishing**,** Magnetorheological and Allied Finishing Processes, Magnetic Abrasive Finishing (MAF), Abrasive Flow Finishing (AFF) for Micromanufacturing,	12

Reference Books:

- Jain V.K., "*Micro manufacturing Processes*", CRC Press.
- Muameer Koç "*Micro Manufacturing: Design and Manufacturing of Micro-Products*", John Wiley & Sons.
- F. Ehmann Kornel, "*Micromanufacturing: International Assessment of Research and Development*", Springer**.**

ELECTIVE-I
MEE464: POWER PLANT ENGINEERING

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** The Sources of Energy, Development of Power Generation in India, Ranking Cycle, Reheat. Regeneration. **Steam Power Plant**: Plant Layout, Working of Different Circuits, Fuel and Handling Equipments, Types of Coals, Coal Handling, Coal Storage and Ash Handling Systems. **Combustion Process**: Properties of Coal Stokers, Fuel Beds, Traveling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System and Its Components, Combustion Needs and Draught System, Cyclone Furnace, Dust Collectors. **Feed Water Treatment, Plant Performance:** Maintenance, Efficiency.	14
II	**Gas Turbine Plant**: Introduction, Classification, Construction – Layout With Auxiliaries – Principles of Working of Closed and Open Cycle Gas Turbines. Combined Cycle Power Plants and Comparisons. **Hydro Electric Power Plant**: Hydrological Cycle, Flow Measurement, Hydrographs – Storage and Pondage, Classification of Dams and Spill Ways. Plant Classification, Typical Layouts, Plant Auxiliaries, Plant Operation **Power From Non-Conventional Sources**: Utilization of Solar- Collectors-Principle of Working, Wind Energy – Types – Hawt, Vawt -Tidal Energy. Solar Energy, Fuel Cells, Thermo Electric and Thermo Ionic, Mhd Generation.	14
III	**Nuclear Power Station**: Nuclear Fuels, Nuclear Reactors, Reactor Operation. Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding – Radioactive Waste Disposal. **Power Plant Economics and Environmental Considerations**: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve, Economic Scheduling, Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor– Related Exercises. **Effluents From Power Plant:** Impact on Environment, Pollutants and Pollution Standards, Methods of Pollution Control.	12

Reference Books:

- Rajput R.K., "*A Text Book of Power Plant Engineering*", Laxmi Publications.
- Sharma P.C. "*Power Plant Engineering*", S.K. Kataria Pub.
- Nag P.K., "*Power Plant Engineering*" II Edition, TMH.
- El Wakil M.M., "*Power Plant Technology*", II Edition, TMH.

ELECTIVE-I
MEE465: TURBO MACHINERY

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction**: Introduction to Turbo Machines. Classification of Turbo Machines. Second Law of Thermo Dynamics - Turbine/Compressor Work, Nozzle/Diffuser Work. Fluid Equations - Continuity, Euler's, Bernoulli's Equation and Its Applications. Vane Congruent Flow, Influence of Relative Circulation, Thickness of Vanes, Number of Vanes on Velocity Triangles, Slip Factor, Stodola, Stanitz and Balje's Slip Factor. Suction Pressure and Net Positive Suction Head. Axial, Radial and Mixed Flow Machines. Similarity Laws. **Flow Through Axial Flow Fans**: Principles of Axial Fan and Propeller. Application of Fans for Air Circulation and Ventilation. Stage Pressure Rise and Work Done. Slip Stream and Blade Element Theory for Propellers. Performance and Characteristics of Axial Fans.	12
II	**Axial Flow Compressors**- Vector Diagrams, Work Done Factor, Temp and Pressure Ratio, Degree of Reaction, Dimensional Analysis, Characteristics, Surging, Polytrophic and Isentropic Efficiencies. **Flow Through Centrifugal Compressors**: Stage Velocity Triangles, Specific Work. Forward, Radial and Backward Swept Vanes. Enthalpy Entropy Diagram, Degree of Reaction, Slip Factor, Efficiency. Vane Less and Vaned Diffuser Systems, Volute As Spiral Casing. Surge and Stall in Compressors.	14
III	**Axial Turbine**: Axial Turbine Stages, Stage Velocity Triangles, Work, Efficiency, Blade Loading, Flow Coefficient. Single Stage Impulse and Reaction Turbines: Degree of Reaction, 50% Reaction Turbine Stage, Radial Equilibrium and Actuator Disc Approach, Partial Admission Problems in Turbines. Losses in Turbo Machines. **Wind Turbine**s: Introduction, Blade Element Momentum Method, Power Output, Control Methods, Blade Tip Shapes, Performance Testing.	12

Reference Books:

- Yahya S.M., "*Turbines, Compressors and Fans*", Tata Mcgraw Hill.
- Prithvi Raj D, Gopalakrishnan G. "*A treatise on Turbo machines*", Scitec Publications, Chennai.
- Sheppard "*Principles of Turbo machinery*", Tata Mcgraw Hill.
- Turton R.K., Chapman, "*Principles of Turbo Machinery*" Hall Publishers, Madras.
- Dixon S. Larry, Butterworth-Heinemann "*Fluid Machinery and Thermodynamics of Turbo Machinery*", Prentice Hall.

ELECTIVE-I
MEE466: ROBOTICS & FMS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Persisted Inefficiency & Desired System, System Configuration, Concept of Flexibility, Flexible Automations-Productivity, Purpose & Motives of Robotization. Robot & Robotics, Basic Element of Robot, Robot Classification, Physical Configuration, Robotic Motion, Resolution, Accuracy & Repeatability, Functional Parameters.	12
II	Robotic System, End Effectors and Grippers, Kinematics & Dynamics of Manipulators, Robot Capabilities, Robot Application-Process Wise & Industry Wise, Selection & Performance Criteria, Robotic Workstation Design, Robot Modularity.	14
III	Planning of Robotized Projects & Economic Justification. Concept, Objectives & Benefits of FMS, Decision & Choice Regarding FMS Configuration, Data Files & Report, Justification & Implements Requirements, Selection of Different System Component, Criteria, Modeling & Performance Evaluation.	14

Reference Books:

- Matthew T. Mason, "*Mechanics of Robotic Manipulation*", Prentice Hall of India, New Delhi.
- Kumar Surender, "*Industrial Robots and Computer Integrated Manufacturing*", Oxford & IBH Publishing Co., New Delhi.
- Rachid Manseur, "*Robot Modeling and Kinematics*", Firewall Media, New Delhi.
- Mukherjee S.K., Kumar Surender, "*Robotic Engineering*", Satya Prakashan, New Delhi.
- Groover, "*Automation, Production System & Computer Integrated Manufacturing*", Prentice Hall India.

ELECTIVE-I
MEE467: INDUSTRIAL AUTOMATION & CONTROL SYSTEMS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Concept and Scope of Industrial Automation, Socio-Economic Considerations, And Pneumatic Logic Circuits: Un-Complementation Algorithm. **Fluid Power Control:** Fluid Power Control Elements and Standard Graphical Symbols for Them, Construction and Performance of Fluid Power Generators, Hydraulic & Pneumatic Cylinders - Construction, Design and Mounting, Hydraulic & Pneumatic Valves for Pressure, Flow & Direction Control, Servo Valves and Simple Servo Systems With Mechanical Feedback, Simple Hydraulic and Pneumatic Circuits.	12
II	**High Volume Production Systems:** Transfer Devices & Feeder, Classification, Construction & Application, Automated Flow Lines, Analysis of Automated Flow Lines for Reliability and Efficiency, Assembly Systems. **Mechatronics:** Mechanical System Interfacing, Simple Mechatronics Devices: Servo Motors, Stepping Motors, DC Motors, Analog / Digital Convertors.Types and Function of Controllers.	14
III	Mathematical Modeling of Physical System and Concept of Transfer Function System. Representation Through Block Diagram and Signal Flow Graph. Time Domain Response Analysis Under Transient Input& Frequency Domain Analysis Root - Locus Techniques, Bode Plot.	14

Reference Books:

- Esposito A., "*Fluid Power with Applications*", Prentice Hal of India, New Delhi.
- Majumdar S. R., "*Pneumatic Systems*", Tata McGraw Hill, New Delhi.
- Groover, M.P., "*Automation, Production Systems & Computer Integrated Manufacturing*", Prentice Hall of India, New Delhi.
- Nise, "*Control system Engineering*" Willey.
- Nagrath & Gopal "*Control System*", TMH.

ELECTIVE-I
MEE468: MECHANICAL VIBRATIONS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Fundamentals of Vibration:** Simple Harmonic Motion, Natural Frequencies and Resonance. **Free and Forced Vibrations of Single Degree of Freedom System:** Newton's Second Law, D'Alembert's Principle, Lagrange's Equation, Springs in Combinations, Types of Damping, Algorithmic Decrement, Equivalent Viscous Damping, Support Excitation, Vibration Isolation and Transmissibility, Vibration Measuring Instruments.	12
II	**Two Degree of Freedom Systems:** Free and Forced Vibrations With and Without Damping, Principle and Normal Modes, Vibration Absorbers. **Multi Degree of Freedom Systems:** Various Methods of Analysis of Multi Degree Freedom Systems, Influence Coefficients, Coupling of Modes, Numerical Methods, Rayleigh's Method, Dunkerley's Equation, Holzer's Method, Application to Torisonal Vibrations.	14
III	**Vibration of Continuous Systems:** Wave Equation, Transverse Vibration of Strings, Longitudinal Vibration of Bars, Lateral Vibrations of Beam. **Whirling of Shafts:** Critical Speed and Effect of Damping. **Introduction to Non-Linear Vibrations.** **Introduction to Condition Monitoring of Machinery, FFT.**	14

Text Book

- Grover G. K., "*Mechanical Vibrations*", Nem Chand and Bros, Roorkee.
- Ambekar A. G., "*Mechanical Vibrations and Noise Engineering*", Prentice Hall of India, New Delhi.

Reference Books

- Rao S. S., "*Mechanical Vibrations*", Addison Wesley Publishing Company, New York.
- Kelly, S. G., "*Mechanical Vibrations, Schaum's Outlines*", Tata McGraw Hill, New Delhi.
- Rao J. S. and Gupta, K., "*Introductory Course on Theory and Practice of Mechanical Vibrations*", New Age International Publication, New Delhi.
- Srinivasan P., "*Mechanical Vibration Analysis*", Tata McGraw Hill, New Delhi.

ELECTIVE-I
MEE469: MECHATRONICS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Integrated Mixed Systems. Integration of Mechanical Engineering, Electronics & Control Engg. and Computer Science. **Dynamic Systems Modeling and Simulation:** Equations of Motion, Transforming, Physical Model to Math. Model, Linearization, Frequency Response.	12
II	**Control Systems:** Performance Specifications, Transfer Functions, Stability, Controller Types and Their Design Using Frequency Domain and Laplace Domain Method, PID Control. Digital Control – Z-Transforms, Problems in Analogue to Digital Conversion-Nyquist Frequency, Digital Controller Design. **Sensors and Actuators:** Temperature Sensors, Stress, Strain and Force Measurements Using Strain Gauges, Piezoelectric Sensors and Accelerometers. Analog / Digital Position Measurements, Velocity Measurements. Direct Current Motors, Stepper Motors, Piezoelectric Actuators.	14
III	**Electronics:** Review of Logic Circuits, Op Amps, AD and DA Converters, Microcontrollers, Digital Signal Processing, Introduction to PLC. **Study of Some Mechatronics Devices:** Hard Disk Drive, Dot Matrix Printer, Optical Sensing and Control Mechanism in NC Machine Tools Etc.	14

Text Book

- Bolton, W., "*Mechatronics: A Multidisciplinary Approach*", Pearson Education, New Delhi.
- Kamm M.L.J., "*Mechatronics*", Prentice Hall of India, New Delhi.

Reference Books

- Auslander D. M. and Kempf C. J., "*Mechatronics: Mechanical System Interfacing*", Prentice Hall, New Jersy.
- Necsulescu D., "*Mechatronics*", Pearson Education, New Delhi.
- Alciatore D.G. and Histand M. B., "*Introduction to Mechatronics and Measurement System*", McGraw Hill, New Delhi.

ELECTIVE-I
MEE470: FINITE ELEMENT METHODS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Finite Element Methods, History and Range of Applications.**Finite Elements:** Definition and Properties, Assembly Rules and General Assembly Procedure, Features of Assembled Matrix, Boundary Conditions.	12
II	**Continuum Problems:** Classification of Differential Equations, Variational Formulation Approach, Ritz Method, Generalized Definition of An Element, Element Equations From Variations. Galerkin's Weighted Residual Approach, Energy Balance Methods.	14
III	**Element Shapes and Interpolation Functions:** Basic Element Shapes, Generalized Co-Ordinates, Polynomials, Natural Co-Ordinates in One-, Two- and Three-Dimensions, Lagrange and Hermite Polynomials, Two-D and Three-D Elements for C^o and C^1 Problems, Co-Ordinate Transformation, ISO-Parametric Elements and Numerical Integration. Application of Finite Element Methods to Elasticity Problems and Heat Transfer Problems.	14

Text Book

- Chandrupatla T. R. and Belegundu A. K., "*Introduction to Finite Elements in Engineering*", Pearson Education, India.
- Huebner K. H., "*The Finite Element Method for Engineers*", John Wiley, New York.

Reference Books

- Bathe K.J., "*Finite Element Procedure in Engineering Analysis*", Englewood Cliffs, Prentice Hall, New York.
- Zienkiewicz O. C., "*The Finite Element Methods*", Tata McGraw Hill, New Delhi.
- Reddy J. N., "*An Introduction to Finite Elements Methods*", McGraw Hill, New York.
- Stasa F.L., "*Applied Finite Element Analysis for Engineers*", Holt, Rinehart and Winston, New York.

ELECTIVE-I
MEE471: BASICS OF NANOTECHNOLOGY

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Size and Shape Dependence of Material Properties at the Nanoscale, Why is Small Good? Limits to Smallness, Scaling Relations, Can Nanorobots Walk and Nanoplanes Fly? Nanoscale Elements in Conventional Technologies **Top-Down and Bottom-Up Nanofabrication:** The Intel-IBM Approach to Nanotechnology: Lithography, Etching, Ion Implantation, Thin Film Deposition, Electron Beam Lithography, Soft Lithography: Nano Imprinting and Micro Contact Printing, Solution/Plasma-Phase Nanofabrication, Sol-Gel Methods, Template Techniques.	12
II	**Self Assembly and Self-Organization:** Functional Coatings With Self Assembled Monolayers of Molecules and Nanoparticles Langmuir-Blodgett Films, Layer-by-Layer Growth. **Imaging/Characterization of Nanostructures:** General Considerations for Imaging, Scanning Probe Techniques: SEM, STM, AFM, And NSOM.	14
III	**Metal and Semiconductor Nanoparticles: S**ynthesis, Stability, Control of Size, Optical and Electronic Properties, Ultra-Sensitive Imaging and Detection With Nanoparticles, Bioengineering Applications, and Catalysis. **Semiconductor and Metal Nanowires:** Vapor/Liquid/Solid Growth and Other Synthesis Techniques, Nanowire Transistors and Sensors. **Carbon Nanotubes :** Structure and Synthesis, Electronic, Vibrational, and Mechanical Properties, How Can C Nanotubes Enable Faster Computers, Brighter TV Screens, and Stronger Mechanical Reinforcement. **Mechanics at Nanoscale:** Enhancement of Mechanical Properties With Decreasing Size, Nanoelectromechanical Systems, Nanomachines, Nanofluidics, Filtration, Sorting, Molecular Motors.	14

Text Book:

- Kelsall, Hamley, and Geoghegan "*Nanoscale Science and Technology*", Wiley.
- Di Ventra, Evoy, and Heflin "*Introduction to Nanoscale Science and Technology*", Kluwer Academic Publishers.

Reference Books:

- Poole and Owens, "*Introduction to Nanotechnology*", Wiley.
- Ozin and Arsenault, "*Nanochemistry: A Chemical Approach to Nanomaterials*", RSC Publishing.

ELECTIVE-I
MEE472: MODERN MANUFACTURING PROCESS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Limitations of Conventional Manufacturing Processes Need of Modern (Unconventional) Manufacturing Processes, Its Classification Based on Their Principal Mechanism and Resources. **Modern Machining Process:** Principle, Working and Applications of Modern Machining Processes Such as Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM), Ultrasonic Machining (USM), Electro-Discharge Machining (EDM).	12
II	**Modern Machining Process (Continued)**: Chemical Machining (CM), Electrochemical Machining (ECM), Electron Beam Machining (EBM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM) Etc. **Modern Forming Processes:** Principle, Working and Application of High Energy Rate Forming (HERF) Processes Such as Explosive Forming, Electromagnetic Forming, Electro-Discharge Forming, Water Hameer Forming, Explosive Compaction Etc.	14
III	**Modern Joining Processes:** Principle, Working and Application of Modern Joining Processes Such as Ultrasonic Welding (USW), Electron Beam Welding (EBW), Laser Beam Welding (LBW), Plasma Arc Welding (PAW), Under Water Welding, Metalizing, Explosive Welding, Cladding Etc. **Electronic-Device Manufacturing:** Brief Description of Diffusion (I.E., Rapid Prototyping) and Photo- Lithography Processes for Electronic-Device Manufacturing.	14

Reference Books:

- Jain V. K., "*Advanced Machining Processes*", Allied Publishers Private Limited.
- Groover M. P., "*Fundamentals of Modern Manufacturing*", John Wiley and Sons.
- El-Hofy H., "*Advanced Machining Processes*", McGraw-Hill.
- Benedict, G. F., "*Nontraditional Manufacturing Processes*", Marcel Dekker, New York.

ELECTIVE-I
MEE473: COMPOSITE MATERIALS

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Composite Materials:** Definition, Classification, Types of Matrices Material and Reinforcements, Characteristics & Selection, Fiber Composites, Laminated Composites, Particulate Composites, Prepegs, and Sandwich Construction. **Macro Mechanics of A Lamina:** Hooke's Law for Different Types of Materials, Number of Elastic Constants, Derivation of Nine Independent Constants for Orthotropic Material, Two - Dimensional Relationship of Compliance and Stiffness Matrix. Hooke's Law for Two Dimensional Angle Lamina, Engineering Constants - Numerical Problems. Invariant Properties. Stress-Strain Relations for Lamina of Arbitrary Orientation, Numerical Problems.	12
II	**Micro Mechanical Analysis of A Lamina:** Introduction, Evaluation of the Four Elastic Moduli, Rule of Mixture, Numerical Problems. **Biaxial Strength Theories:** Maximum Stress Theory, Maximum Strain Theory, TSA-Hill Theory, Tsai, Wu Tensor Theory, Numerical Problems.	14
III	**Macro Mechanical Analysis of Laminate:** Introduction, Code, Kirchoff Hypothesis, CL T, A, B, and D Matrices (Detailed Derivation) Engineering Constants, Special Cases of Laminates, Numerical Problems. **Manufacturing:** Lay Up and Curing - Open and Closed Mould Processing, Hand Lay, Up Techniques, Bag Moulding and Filament Winding. Pultrusion, Pulforming, Thermoforming, Injection Moulding, Cutting, Machining and Joining, Tooling. **Application Developments:** Aircrafts, Missiles, Space Hardware, Automobile, Marine, Recreational and Sports Equipment-Future Potential of Composites. **Metal Matrix Composites:** Re-Inforcement Materials, Types, Characteristics and Selection, Base Metals, Selection, Applications.	14

Text Book:

- Schwartz Mein, "*Composite Materials Handbook*", Mc Graw Hill Book Company.
- K. Kaw Autar "*Mechanics of Composite Materials*", CRC Press New York.
- Mukhopadhyay Madhujit, "*Mechanics of Composite Materials and Structures*", University Press.

Reference Books:

- Rober M. Joness, "*Mechanics of Composite Materials*", Mc-Graw Hill Kogakusha Ltd.
- Michael W, "*Stress Analysis of Fiber Reinforced Composite Materials*", Hyer MGH International.
- Krishan K. Chawla, "*Composite Material Science and Engineering*", Springer.

ELECTIVE-I
MEE474: RELIABILITY AND MAINTENANCE ENGINEERING

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Maintenance Management, Production Maintenance System, Objectives and Functions, Forms, Policy, Planning, Organization, Economics of Maintenance, Evaluation of Maintenance Management. **Maintenance Strategies:** Break Down Maintenance, Preventive Maintenance, Planned Maintenance, Maintenance Programme, Job Report, Strategies.	12
II	Design Out Maintenance, Planned Lubrication, Total Productive Maintenance, Zero Break Down Manpower Planning, Materials Planning, Spare Parts Planning and Control. **Reliability Engineering:** Introduction, Operating Life Cycle, Reliability, Failure Data Analysis, Failure Rate Curve, Hazard Models, Elements in Series, Parallel, Mix, Logic Diagrams, Improving Reliability, Redundancy-Element, Unit, Standby, Maintainability, Availability, Reliability and Maintainability Trade Off.	14
III	Break Down Maintenance Planning, Replacement Planning Maintain or Replace Decision, Replacement Models/ Decisions, Individual, Group Replacement, Replacement in Anticipation of Failure. **Condition Monitoring:** Objectives and Techniques of Condition Monitoring.	14

Text Book:

- Mishra R.C. & Pathak K., "*Maintenance Engineering & Management*", Prentice Hall of India, New Delhi
- Gupta A.K., "*Reliability Maintenance & Safety Engineering*", University Science, Press New Delhi.

OPEN ELECTIVE
MEE451: SOFT COMPUTING TECHIQUES

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Artificial Neural Networks (Introduction & Architecture)** Neuron, Nerve Structure and Synapse, Artificial Neuron and Its Model, Activation Functions, Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks. Various Learning Techniques; Perception and Convergence Rule. Basic Concepts - Supervised and Unsupervised Learning-Single Layer Perception - Multilayer Perception. **Back Propagation Networks** Back Propagation Networks - Kohnen's Self Organizing Networks - Hopfield Network. Effect of Learning Rule Co-Efficient; Back Propagation Algorithm, Factors Affecting Back Propagation Training, Applications.	13
II	**Fuzzy Systems** Basic Concepts of Fuzzy Logic, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and Operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp Conversion. Membership Functions, Interference in Fuzzy Logic, Fuzzy If-Then Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Decision Making. Fuzzy Controller, Industrial Applications.	14
III	**Neuro - Fuzzy Modeling** Adaptive Networks Based Fuzzy Interface Systems - Classification and Regression Trees - Data Clustering Algorithms - Rule Based Structure Identification - Neuro-Fuzzy Controls - Simulated Annealing – Evolutionary Computation. **Genetic Algorithms** Basic Concepts, Working Principle, Procedures of Ga, Flow Chart of Ga, Genetic Representations, (Encoding) Initialization and Selection, Genetic Operators Cross Over - Mutation – Reproduction, Generational Cycle, Fitness Computations ,Applications.	13

Text Book:

- Rajsekaran S. & Vijayalakshmi Pai G.A., "*Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications*", Prentice Hall of India.
- Padhy N.P., "*Artificial Intelligence and Intelligent Systems*", Oxford University Press.

Reference Books:

- Haykin Siman, "*Neural Netowrks*", Prentice Hall of India.
- Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", Wiley India.
- Kumar Satish, "*Neural Networks*", Tata Mc Graw Hill.

OPEN ELECTIVE
MEE452: TOTAL QUALITY MANAGEMENT

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Definition of Quality & Total Quality, World Scenario, Quality Education, Drivers of Quality, Principles of Quality Management, Internal and External Customers, Vision, Mission, Objectives & Targets, Ten Principles of Quality Management, Evaluation of TQM, Stages of Implementation of TQM, TQM Models. **Quality Planning:** SWOT Analysis, Strategic Planning, Organizational Culture, Management of Change. **Customer Orientation:** Customer Focus, Customer Satisfaction Models, Customer Retention, Measurement of Customer Satisfaction, Quality Function Deployment.	13
II	**Quality Solving Tools:** Process of Solving Problems – Conventional Methods, 7 Modern Management Tools. **Continuous Improvement Strategies:** Deming Wheel, Zero Defect Concept, Benchmarking, Six Sigma (6σ), Preventive Techniques – Failure Mode & Effect Analysis (FMEA), Five S of Housekeeping, Time Management, Total Productive Maintenance **Human Dimensions of TQM:** Top Management Commitment, Leadership for TQM, Motivational Strategies, Quality Circles, Team Development & Building, Communication and Transactional Analysis.	14
III	**Quality Certification:** ISO 9000 Quality Management System (QMS), ISO 14000 Series, Qs 9000 Series, Quality Auditing, Quality Awards, Quality Certifying Agencies, Business Excellence Models. **Cost of Quality** - Prevention Cost, Appraisal Cost, Internal Failure Cost, External Failure Cost, TQM Roadmap, How TQM Fails, TQM Implementation Strategies. **Contribution of TQM Gurus:** W. Edwards Deming, Juran Crosby, Ishikawa, Kaisen and Their Theories for Total Quality.	13

Reference Books:

- Suganthi L., A. Samuel Anand, "*Total Quality Management*", PHI Learning.
- Bedi Kanishka, "*Quality Management*", Oxford University Press.
- Juran J.M., M. Gryna Franic, "*Quality Planning and Analysis*", Tata McGraw Hill Edition.
- Kumar S., "*Total Quality Management*", University Science Press.

OPEN ELECTIVE
MEE453: SUPPLY CHAIN MANAGEMENT

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction to Supply Chain Management (SCM)** Role of Supply Chain Management, Scope and Importance: Historical Evolution of SCM, Building Blocks of Supply Chains: Inbound Logistics, Operations, Outbound Logistics, Forecasting, Inventory Strategy, Transportation Strategy, Warehouse Management. Information Strategy for SCM. Supply Chain Performance, Supply Chain Drivers and Metrics.	12
II	**Capacity Planning and Forecasting in Supply Chains** Demand Forecasting is Supply Chains, Aggregate Planning in Supply Chains, Managing Predictable Variability in Demand and Supply in Supply Chains, Managing Economics of Scale: Cycle Inventory Managing Uncertainty in A Supply Chain: Safety Inventory , Determining the Optimal Level of Product Availability	13
III	**Design of Networks** Designing Distribution Networks and Applications to E-Business, Network Design in the Supply Chain , Network Design in An Uncertain Environment, Sourcing Decisions in A Supply Chain , Pricing and Revenue Management in A Supply Chain, Information Technology in A Supply Chain, Coordination in A Supply Chain	13

Reference Books:

- Chopra Sunil, Meindl Peter and Kalara D.V., "*Supply Chain Management, Strategy, Planning and Operation*", Pearson Education Inc, 2007.
- Ronald H. Ballou, "*Business Logistics Management*", Prentice Hall.
- Mohanty R. P., S. G. Deshmukh, "*Supply chain Management*", Phoenix Publishing.

OPEN ELECTIVE
MEE454: NON-CONVENTINOAL ENERGY RESOURCES

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	Review and Impact of Fossil Fuel Based Systems. Traditional Energy Sources:- Features, Characteristics and Applications. Non-Conventional Energy– Introduction, Seasonal Variations and Availability, Features Advantage, Disadvantage. Criteria for Assessing the Potential of NCER. Classification of NCER. Comparison of NCER With Traditional and Fossil Based System. Distributed Energy Systems and Dispersed Generation (DG), Energy Exploited, Energy Planning. **Solar Energy:** Solar Radiation and Its Characteristics Solar Constant, Different Sun Earth Angles, Calculation of Solar Radiation, Solar Time, Day Length, Sunrise and Sunset, Solar Radiation Spectrum Solar Thermal Energy. **Solar Collector:** Introduction, Classification and Application. **Solar Pond:** Introduction and Its Types. **Application of Solar Thermal Energy:** Cooling, Drying, Distillation, Power Generation, Solar Cooking, Space Heating and Cooling, Solar Water Heating. **Solar Photovoltaic Systems:** Basic Concept, Operating Principles Its Application.	15
II	**Wind Energy:** Principle of Wind Energy Conversion, Site Selection Criterion, Concept of Lift and Drag. **Wind Turbine:** Design Consideration, Types of Wind Mill, Construction Details of Wind Turbine, Wind Turbine Rotor and Its Types. Application of Wind Energy. Advantage and Limitation of Wind Energy Conversion. Determination of Torque Coefficient. **Bio-Mass:** Availability of Bio-Mass and Its Conversion Theory. Design Consideration of Biogas Plants. Different Biogas Generation Plants and Their Construction Details. Biomass Gasifier. **Biogas:** Properties and Utilization **Concept of Bio Diesel:-** Development , Advantage and Limitation. **Wave Energy Systems:** Shoreline Systems. Near Shore Systems. Off Shore Systems **Ocean Thermal Energy Conversion (OTEC):** Basic Concept, Working Principle, Performance, Types and Limitations. **Tidal Wave:** Principle of Working, Performance, Types and Limitations.	15
III	**Hybrid Systems:** Need for Hybrid Systems. Range and Type of Hybrid Systems. Case Studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel Systems, Electric and Hybrid Electric Vehicles **Fuel Cells:** Basic Concept and Working Principle Fuel Cells, Application Advantage And limitations. **Geo Thermal Energy:** Nature of Geothermal Sources, Principle, Location, Economics and Prospect. Classification of Resources, Utilization for Electric Generation and Direct Heating, Well Head Power Generating Units. **Energy Management:** Energy Economics, Energy Audit. Contribution of NCER At Global and Indian Level.	10

Reference Books:

- Gabdel Andra, "*A Handbook for Engineers and Economists*", TMH.
- Auer Peter, "*Advances in Energy System and Technology*", Vol. 1 & II Edited by Academic Press.
- F.R. the MITTRE, "*Wind Machines*", by Energy Resources and Environmental Series.
- Chermisinogg N. and Thomes, Regin C., "*Principles and Application of Solar Energy*", WDL Pub.

- Palz W., Chartier P. and Hall D.O., "*Energy from Biomass*", Applied Science Publishers.
- Rai G.D., "*Non-conventional Energy sources*", Khanna Publishers.
- Khan B.H., "*Non-Conventional Energy Resources*", Tata McGraw-Hill Education.

OPEN ELECTIVE
MEE455: ENTERPRENURESHIP DEVLOPMENT PROGRAMME

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction To Entrepreneurship:** Evolution of the Concept of Entrepreneur Functions of Entrepreneur, Characteristics of An Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship, Growth of Entrepreneurship , Barriers of Entrepreneurship, Role of Entrepreneurship in India, Entrepreneurial Motivation, Major Entrepreneurial Competencies. **Small Scale Industries (SSI):** Characteristics of Small Scale Industry, Basis for Classification of Small Scale Industry: Resource Based, Demand Based, Ancillary, Subsidiary Based or Sub – Controlled Type, Technology Based Etc. Government Policy for Small Scale Industry, Growth of SSI in Developing Countries, Role of National and State Agencies Providing Assistance To SSI's, Relationship Between Small and Big Industries, Ownership Structure, Registration of SSI.	12
II	**Project Identification and Project Formulation** Meaning of Project, Project Identification and Selection, Elements of Project Formulation, Concept and Significance of Project Formulation, Meaning, Significance and Contents of Project Report. **Accounting for Small Enterprises** Objective of Accounting, Accounting Process, Journal, Ledger, Preparation of Balance Sheet and Assessment of Economic Viability. **Project Appraisal** Concept of Project Appraisal ,Project Appraisal Methods ,Cash Flows As Costs and Benefits, Payback Period, Average Rate of Return ,Discounted Cash Flow Techniques, Working Capital Management, Cost of Capital, Financing of Enterprises, Project Sickness & Corrective Measures.	14
III	**Marketing Management:** Market Segmentation, Marketing Mix, and Packaging, Pricing Policy, Distribution Channels, And Govt. Purchases From SSIS. **Laws Concerning Entrepreneur**: Income Tax Laws, Excise Duty ,The Central Sales Tax ACT, Professional Tax, Value Added Tax (VAT), Service Tax, The Workmen Compensation Act, The Minimum Wages Act, The Maternity Benefit Act, The Payment of Bonus Act **Institutional Support:** Government Policies for Small Scale Entrepreneurs, Institutional Setup, District Industries Centers, Industrial Estates ,SIDCO, NSIC, Directorate of Industries, Commercial Banks, New Entrepreneurial Development Agencies. **Women Entrepreneurship:** Growth, Problems, Recent Trends.	14

Reference Books:

- Khanka S.S., "*Entrepreneurial Development*", S. Chand & Company Ltd.
- Gupta C.B., Srinivasan N.P., "*Entrepreneurship Development in India*", S. Chand & Sons.
- Badhai B., "*Entrepreneurship Development Programme*", Mansell Publishing Ltd.
- Desai V., "*Dynamics of Entrepreneurial Development & Management*", Hindustan Publishing House.
- Holt David. H., "*Entrepreneurship*", PHI Learning.
- Roy Rajeev, "*Entrepreneurship*", Oxford University Press.

OPEN ELECTIVE
MEE456: PROJECT MANAGEMENT

Credits: 04 **Semester VII & VIII** **L–T–P: 3–1–0**

Module No.	Contents	Teaching Hours
I	**Introduction:** Project Characteristics, Attributes of A Good Project Manager, Taxonomy of Projects. **Project Identification & Formation:** Project Identification, Demand Forecasting, Project Preparation, Zero Based Project Formulation, Preliminary Project Report, Comparison of Project Alternatives. **Project Appraisal:** Technical Appraisal, Commercial Appraisal, Economical Appraisal, Management Appraisal, Social Cost Benefit Analysis, NPV, IRR, BCR, NBCR.	14
II	**Financing of Projects:** Estimation of Cost Components of Projects. Sources of Finances, Role of Financial Institutions, Cash Inflow and Cash Outflow, Cost of Capital. **Project Planning & Scheduling:** Scheduling Techniques, PERT & CPM, Network Preparation, Updating Network, Line of Balance Technique, Performance Analysis of Projects, Cost Vs Time of Completion, Normal Time and Crash Time, Resource Allocation Techniques, Work Breakdown Structure.	14
III	**Project Contracts:** Types of Contract, Sub-Contract, Tenders & Types of Payment to Contractors. **Computer Aided Project Management:** Essential Requirements of Software's, Software Packages, Enterprise-Wide Project Management, Spread Sheets. Project Organization, Post Project Evaluation, Project Sickness – Causes, Prediction of Causes, Rehabilitation, Project Audit, Risk Analysis.	12

Reference Books:

- Nagarajan K., "*Project Management*", New Age International Publishers.
- Panneerselvam R. & Senthilkumar P., "*Project Management*", PHI Learning.
- Patel Bhavesh M, "*Project Management*", Vikas Publishing Home.
- Scelharaman S. & Ramnath Vijay, "*Project Management*" Breweries; Education.