ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
MECHANICAL ENGINEERING

3rd SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure
(From Academic Session 2018-19 onwards)

B.Tech 3rd Semester: Mechanical Engineering

Semester III/B.TECH/ME

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	MA181301A	Mathematics III-A (for branches other than CSE and ECE/ETE)	2	1	0	3	30	70
2	EE181302	Electrical Technology	3	0	2	4	30	70
3	ME181303	Basic Thermodynamics	3	0	2	4	30	70
4	ME181304	Theory of Machines	3	0	0	3	30	70
5	ME181305	Machine and Assembly Drawing	2	0	2	3	30	70
6	MC181306	Constitution of India	2	0	0	0 (PP/NP)	-	100
Practical								
1	ME181314	Theory of Machines Lab	0	0	2	1	15	35
2	SI181321	Internship-I (SAI - Social)	0	0	0	1	-	100
TOTAL			15	1	8	**19**	**165**	**585**
Total Contact Hours per week : 24								
Total Credits: 19								

N.B. MC181306 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
MA181301A	**Mathematics III-A** (for branches other than CSE and ECE/ETE)	**2-1-0**	**3**

MODULE 1: Partial Differential Equation: (15 Hours)
Formation of Partial Differential equations, Linear partial differential equation of first order, Non-linear partial differential equations of first order, Charpit's method, Method of separation of variables, boundary value problem with reference to the one dimensional heat and wave equation.

MODULE 2: Probability Theory: (15 Hours)
Review of basic probability and Bayes' theorem, Probability distribution, Binomial, Poisson and normal distribution, Joint distribution, Test of significance, fitting of straight line by least square method, Elementary concept of Markov Chain.

MODULE 3: Laplace Transform: (10 Hours)
Laplace transform of elementary function, Properties of Laplace transform, inverse Laplace transform, convolution theorem, Solution of ordinary differential equations with the help of Laplace transform.

Textbooks/References:

1. Advanced Engineering Mathematics: Erwin Kreyszig
2. Higher Engineering Mathematics: B V Ramana
3. Theory and problems of Probability: Seymour Lipschutz
4. A text book of engineering Mathematics: N. P. Bali & M. Goel
5. Statistical Methods: An Introductory Text- J.Medhi, New Age International Publishers

Course Code	Course Title	Hours per week L-T-P	Credit C
EE181302	**Electrical Technology**	**3-0-2**	**4**

COURSE OVERVIEW:
The purpose of the course is to teach principles of AC and DC motors and generators, and AC transformers and how they work. Basic concepts of electromagnetic circuits as they relate to voltages, currents, and physical forces induced in conductors are covered, including application to practical problems of machine design. It also includes the study of alternators, synchronous motors, poly phase induction motors and single-phase motors.

Course Objectives
1. Student will be taught the working principle of electric motors/ generators and transformer based upon fundamental theories after getting detailed knowledge of construction, operating principles.
2. Student will be benefited by acquiring knowledge of construction, operating principles of induction motors and can analyze performance parameters of single as well as three phase induction motors.
3. Students will understand the working principle and behavior of synchronous machines along with various area of applications.
4. Students will get the knowledge of power measuring instruments along with their errors.

Motivation:
The objective is to motivate the students in learning electrical machines and strengthening knowledge towards practical work.

Course Outcome (CO):
After the successful completion of the course student should be able to:

CO1: Apply knowledge to relate the constructional details with the performance analysis of DC machine.

CO2: Articulate the concept of 1 phase transformer and complete an analysis.

CO3: Analyze and differentiate the working principle of 3 phase and 1 phase Induction Motor along with various areas of applications.

CO4: Apply knowledge on operation of synchronous machines and analyze variation of excitation with power factor under different loading conditions.

CO5: Analyze the performance of the measuring instruments and identify their errors.

MODULE 1: D C Machines:
i. Basic Constructional features, E M F equation of D C generator, Elementary Idea of DC machine winding-winding pitch, Lap and Wave windings. Types of generators. Characteristics of DC generator-the OCC and the load characteristics. The shunt generator-condition for voltage builds up. Load characteristics. Losses in a DC generator, Efficiency, Applications, Compound generators
ii. Working principle of DC motor. Back EMF, Calculation of torque and power. Types of DC motors. Characteristics curves. Losses and Efficiency. Speed equation. Method of speed control. Method of starting. The 3 point, 4-point starter (calculations of the star resistors not required)

MODULE 2: Transformer:
Physical description of transformer. Elementary theory of the ideal transformer, EMF equation, Voltage and current transformation ratio. No load and load phasor diagrams. Transformer reactance and impedances. Equivalent resistance & reactance. Simplified equivalent circuit, open and short ckt tests. Losses and efficiency. Condition for maximum efficiency. All day efficiency.
Voltage regulation. The auto transformer, basic working principle.

MODULE 3: Induction motor:
Constructional features of 3-ph induction motor-principle of rotating magnetic field (mathematical treatment not required) Principle of operation of the 3-ph induction motor speed. Rotor emf, current and rotor cu loss, Torque, Starting torque. Maximum torque. Condition for maximum torque. Torque slip curves. Necessity of a starter. Methods of starting of squirrel cage and the slip-ring induction motors.
Introduction to single phase induction motor. Nature of a field and torque produced in single phase induction motors (details of double revolving field not required). Types of motors-split phase, capacitors motors.

MODULE 4: A.C. Synchronous machines:
Principle of operation of alternators. Constructional features of cylindrical generators and salient pole alternator, EMF equation.
Principle of operation of the synchronous motor, Synchronous motor on no load, Synchronous motor on load, Behaviour of the Synchronous motor with change of excitation curves. Starting methods of Synchronous Motor. Application of Synchronous motor.

MODULE 5: Measuring Instruments:
Dynamometer type wattmeter. Induction type wattmeter. Single phase induction type energy meter. Errors and compensations.

Textbooks/References:

1. Theraja: A Text book of Electrical Technology.
2. K. Krishna Reddy: Electrical Machines-I, II, III
3. Electrical Technology: Vaidya, Bhagwat, God bole
4. Kothari D.P., and Nagrath, I.J., 'Electrical Machines', Tata McGraw Hill
5. Electrical Measurements and Measuring Instruments – A.K. Shawney (Dhanpat Rai)
6. Langsdrof: 'Theory of Alternating Current Machines' Tata McGraw Hill
7. Kingsley, Fitzereld: Electric Machinery (McGraw Hill)
8. Ashfaq Husain, Electric Machines, Dhanpat Rai

Suggested Practical:

Course Objectives:
The Electrical Technology Laboratory is designed to provide the students with the practical knowledge of electrical machines specifically keeping in view the following objectives:

i. to get hands-on experience in performing the basic tests on electrical machines
ii. to reinforce the theoretical concepts with related practical understanding
iii. to know about the various precautionary measures necessary in handling electrical machines
iv. to develop technical report writing skill

Course Outcome (CO):

CO1: Students will be able to apply knowledge on operation of electrical machines (DC motor/generator, transformers) and relate theoretical concepts with experimentation.

CO2: Students will be familiar with the mode of starting, switching-off, and taking pre- cautionary measures while handling electrical machines.

CO3: Students will be able to write effective reports and design documentation after performing an experiment.

LIST OF EXPERIMENTS

1. Open circuit characteristic of a dc generator.
2. Load test on a dc shunt generator.
3. Speed control of dc shunt motor.
4. Open circuit and short circuit test on a single phase transformer
5. Load test on a single phase transformer.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181303	**Basic Thermodynamics**	**3-0-2**	**4**

Objective:

i. To impart knowledge on the laws of thermodynamics and their application along with the knowledge of various cycles.
ii. To give an idea on the mechanism behind the working of different cycles and to develop the ability to analyze and solve problems related with thermodynamics
iii. To provide the exposure to fuel and combustion to solve a wide variety of engineering problem.

Motivation:
The knowledge of Basic Thermodynamics has wide application in mechanical engineering. All natural processes are governed by the principles of thermodynamics. Automotive engines, Turbines, Compressors, Pumps, Fossil and Nuclear Power Plants, Propulsion systems for the Aircrafts, Separation and Liquefaction Plant, Refrigeration, Air-conditioning and Heating Devices are some of the engineering devices which are typically designed based on the principles of thermodynamics.

Course Outcomes (CO): At the completion of the course the student will be able
CO1: Illustrate the basic concepts of thermodynamics and its approaches for conversion of heat and work.

CO2: Apply the laws of thermodynamics in steady flow processes in devices, namely nozzles and diffusers, turbines and compressors, throttle device, water turbine, heat exchangers, for energy conversion and employ the concept of irreversibility.

CO3: Relate through diagrams properties of steam for suitable application in the field of energy conversion

CO4: Illustrate graphically and analytically the working of air standard cycles applied in internal combustion engines, namely, Otto cycle, diesel cycle, dual cycle.

CO5: Examine the various properties of fuel through various experiments to determine their suitability for combustion applications.

MODULE 1: System and Continuum:
Intensive and Extensive properties – Thermodynamic state, pressure, energy, work and heat – process and cycle – Macroscopic and Microscopic points of view – Kinetic theory of gases

MODULE 2: Laws of thermodynamics:
Zeroth law – Concept of equilibrium– Principles of therm. Fixed points. First law of thermodynamics and its application to open and closed systems Concept of internal energy – Steady flow energy equation – Processes of closed systems. Second law of thermodynamics – Various statements – Carnot cycle – Irreversible and Irreversible processes – Thermodynamic efficiency and temperature scales – Concept of entropy – Entropy changes in various processes.

MODULE 3: Properties of steam:
Latent heat – Saturation pressure and temperature – Dryness fraction – Degree of superheat – Total heat; Rankine cycles (use of steam tables, Mollier chart and other property diagrams).

MODULE 4: Air standard cycles:
Otto, Diesel and dual cycles. Principles of working of two and four stroke SI and CI engines – Representations of processes on T-s and p-v diagrams and comparisons of efficiencies.

MODULE 5: Fuels and Combustions:
Classification of fuels; HCV, LCV, Bomb Calorimeter, Boy's gas calorimeter; Combustion of fuels; Minimum air required (by weight and by volume); Conversion of volumetric analysis into weight analysis and vice versa; excess air and Orsat apparatus.

Textbooks/References:

1. Engineering thermodynamics by P K Nag
2. Fundamentals of Thermodynamics by Cengel and Boles

Practical:

Objective:

i. To impart knowledge on the basic thermodynamic properties.
ii. To give the idea of different types of boilers and its mounting and accessories.
iii. To give the idea of practical knowledge of two stroke and four stroke engines and their thermodynamic cycles.

Course Outcomes (CO): At the completion of the course the student will be able to:

CO1: Understand the basic concept of thermodynamic properties such as temperature and pressure

CO2: Understand the basic differences of different types of boilers, from the study of cut models, such as vertical tube boiler, Cochran boiler together with their mountings.

CO3: Understand the working principles of Internal Combustion Engines, from the study of cut models, such as 2 stroke and 4 stroke petrol engine, 4 stroke diesel engine

LIST OF EXPERIMENTS

1. To study thermodynamic properties such as temperature and pressure in different condition with thermometer and pressure gauge.
2. To study the mountings and accessories of boilers like vertical tube boiler and Cochran boiler with the help of cut models.
3. To study the working principle of Internal Combustion Engines such as 2 stroke and 4 stroke Petrol Engine and 4 stroke Diesel Engine with the cut models.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181304	**Theory of Machines**	**3-0-0**	**3**

Course Outcomes (CO): At the completion of the course the student will be able

CO1: Analyze the kinematic analysis of a given mechanism.

CO2: Analyze the motion and dynamic forces acting on mechanical motion transmitting element composed of gears, belts, cams

CO3: Apply the concept of mechanical control mechanism to reduce fluctuation of speed and energy.

CO4: Apply the fundamental principles of friction for effective transmission of power and intermittent control of speed.

CO5: Apply the concept of theory of machine in mechanical engineering system for appropriate transmission power and motion.

MODULE 1: SIMPLE MECHANISMS
Link, Pair, chain, mechanism and inversions. Simple mechanism, Slider crank, four bar, straight line steering. Simple velocity and acceleration diagrams,

MODULE 2: GOVERNOR
Watt and Porter governors. Spring controlled centrifugal governor – Hartnell, Hartung, Wilson – Hartnell, Inertia governors. Stability, Effects of friction, Isochronism, Hunting, effort and power.

MODULE 3: CAM
Introduction, classification of cams and followers, Displacement diagram, graphical layout of cam profiles

MODULE 4: FRICTION AND FRICTION DRIVES
Types of friction, Uniform Pressure and Uniform Wear, Friction Clutches, Rolling Friction, Flat Belt, V Belt and Rope Drives, Velocity Ratio in Belt Drives, Law of Belting, Ratio of Friction Tensions in Belts, Power Transmitted by Belts and Ropes, Maximum Power Transmission by Belt, Types of Brakes, Block and Shoe Brake, Band Brake, Internal Expanding Shoe Brake, dynamometer

MODULE 5: TM DIAGRAM AND FLYWHEEL
Fluctuations of energy, Co-efficient of fluctuation of energy and speed, function of flywheel.

MODULE 6: GEAR AND GEAR TRAIN Nomenclature, types – simple, compound, epicyclic gear train including reverted gear train. Simple description of automobile gear train.

Textbooks/References:

1. Ratan, S.S., Theory of Machines, Tata McGraw Hill Publishing company Ltd., 2nd Edition, 2005.
2. Singh Sadhu, Theory of Machine, Pearson Education
3. Singh V.P., Theory of Machines

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181305	**Machine and Assembly Drawing**	**2-0-2**	**3**

Objective:

i. To impart knowledge on various basic mechanical parts and its construction.
ii. To give an idea on functioning of the parts
iii. To proffer knowledge on assembling of the parts of engine and valves

Motivation:
This is a very basic subject which will improve the visualization skill for evolving mechanical parts. It will also provide the knowledge on how the various mechanical parts are to be built by assembling some small elementary parts. Knowledge of the subject will also furnish the better understanding of machine design, workshop theory, theory of machine and IC engine to the students.

Course Outcomes (CO): At the completion of the course the student will be able to:

CO1: Illustrate and draw the profiles of thread and locking devices such as nuts and bolts

CO2: Sketch various joints-key and cotter joints, riveted joints, welded joints, coupling, pipe joints as well as machine elements.

CO3: Assemble basic engine parts and components such as piston, staffing box, cross head, connecting rod, eccentric

CO4: Assemble elementary mechanical parts to construct valve like feed check valve, stop valve, blow off cock, non-return valve.

CO5: Develop solid models of various machine elements in CAD.

MODULE 1: Screw Fasteners:
Introduction, Screw Thread Nomenclature, Forms of Thread, Thread Profiles- V-Thread, Buttress Tread, British Standard with worth (B.S.W) Thread, Square Thread ACME Thread, Worm Thread, Thread designation, Multistart Thread, left hand thread, right hand thread, Locking devices for nuts, Different types of bolts and nuts.

MODULE 2: Key Cotter and Pin Joints:
Introduction, Saddle Key, Sunk Key, Cotter Joint with Sleeve, Cotter Joint with Socket and Spigot Ends, Cotter Joint with a Gib, Pin Joints-Knuckle joints.

MODULE 3: Riveted and Welded Joints:
Introduction, Rivets and Riveting, Rivet heads, Definitions-Pitch, Margin, Chain Riveting, Zig-Zag Riveting, welded joints and Symbols, Dimensioning of welds, Edge preparation of Welds.

MODULE 4: Coupling and pipe joints:
Introduction, Rigid Coupling-Flanged Coupling, Sleeve or Muff Coupling, Flexible Coupling – Bushed pin type Flanged Coupling, Pipe Joints- Flanged join, Hydraulic Joints.

MODULE 5: Assembly Drawings:

a) Engine Parts: Stuffing Box, Crosshead, Connecting Rod, Eccentric, Piston
b) Valves: Stop Valve, Feed Check Valve, blow off Cock, Non Return Valve

MODULE 6: Computer Aided Drafting:

2D Drawing, Solid Modeling

Textbooks/References:

1. Machine Design by N.D Bhatt
2. Machine Design by K.L. Narayan

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181306	**Constitution of India**	**2-0-0**	**0**

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

MODULE 1: History of Making of the Indian Constitution:

a) History
b) Drafting Committee, (Composition & Working)

MODULE 2: Philosophy of the Indian Constitution:

a) Preamble
b) Salient Features

MODULE 3: Contours of Constitutional Rights & Duties:

a) Fundamental Rights
b) Right to Equality
c) Right to Freedom
d) Right against Exploitation
e) Right to Freedom of Religion
f) Cultural and Educational Rights
g) Right to Constitutional Remedies □ Directive Principles of State Policy □ Fundamental Duties.

MODULE 4: Organs of Governance:

a) Parliament
b) Composition
c) Qualifications and Disqualifications

d) Powers and Functions
e) Executive
f) President
g) Governor
h) Council of Ministers
i) Judiciary, Appointment and Transfer of Judges, Qualifications
j) Powers and Functions

MODULE 5: Local Administration:

a) District's Administration head: Role and Importance,
b) Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation.
c) Pachayati raj: Introduction, PRI: Zila Pachayat.
d) Elected officials and their roles, CEO Zila Pachayat: Position and role.
e) Block level: Organizational Hierarchy (Different departments),
f) Village level: Role of Elected and Appointed officials,
g) Importance of grass root democracy

MODULE 6: Election Commission:

a) Election Commission: Role and Functioning.
b) Chief Election Commissioner and Election Commissioners.
c) State Election Commission: Role and Functioning.
d) Institute and Bodies for the welfare of SC/ST/OBC and women.

Textbooks/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181314	**Theory of Machines Lab**	**0-0-2**	**1**

Course Outcomes (CO): At the completion of the lab, the student will be able to

CO1: Compare analytical results with observed results and infer the cause of variation.

CO2: Determine the stability characteristics of governor for appropriate selection in future engineering applications

CO3: Apply the concept of dynamometer for power measurement.

CO4: Identify appropriate cam for engineering applications.

LIST OF EXPERIMENTS

1. Study of slider crank mechanism
2. Study of gear trains
3. Analysis of porter governor
4. To determine the co-efficient of friction between belt & pulley
5. Power measurement using the principle of dynamometer
6. Cam analysis

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH

MECHANICAL ENGINEERING

4th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure
(From Academic Session 2018-19 onwards)

B.Tech 4th Semester: Mechanical Engineering

Semester IV/ B.TECH/ME

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	ECE181407	Applied Electronics	3	0	2	4	30	70
2	ME181402	Workshop Theory and Practice-I	3	0	2	4	30	70
3	ME181403	Fluid Mechanics-I	3	0	0	3	30	70
4	ME181404	Materials Science	3	0	2	4	30	70
5	ME181405	Mechanics of Materials	3	0	0	3	30	70
6	MC181406	Environmental Science	2	0	0	0 (PP/NP)	-	100
Practical								
1	ME181413	Fluid Mechanics–I Lab	0	0	2	1	15	35
2	ME181415	Mechanics of Materials Lab	0	0	2	1	15	35
TOTAL			17	0	10	**20**	**180**	**520**
Total Contact Hours per week : 27								
Total Credit: 20								

NB: 1. MC181406 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)
2. 2-3-weeks Mandatory Academia Internship need to be done in the 4th semester break and the report is to be submitted and evaluated in 5th semester

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
ECE181407	Applied Electronics	3-0-2	4

Objective: -
To introduce theory and applications of electronic devices and their characteristics, operational principles; knowledge of circuits like power supplies, regulators, amplifiers etc. also combinational and sequential digital circuits, sensors, timers, motors etc. and their uses in various industrial applications.

Outcome: -
Student is expected to understand the basic principle of electronic devices used in various analog and digital circuits and their applications in real life situations.

MODULE 1: Study of Semiconductor Devices
A brief overview of atomic structure, periodic table, chemical bonding and quantum mechanics, Semiconductor - intrinsic & extrinsic, Energy-band, Fermi level, Direct & indirect semiconductor, drift & diffusion current.

MODULE 2: Diodes
PN junction diode, Diode characteristics for forward bias & reverse bias, different characteristic parameters of diode, Rectifiers, DC power supply, Break-down of diode, Zener-diode & its application as voltage regulator, Working principle of LED, LCD, photo-diode & seven segment LED display.

MODULE 3: Transistors
BJT & UJT, BJT characteristics for CB, CE & CC; BJT as switch, Biasing of BJT & operating point, BJT amplifier, Differential amplifier, Op-Amp model and its application as inverting, non-inverting amplifier; unity gain buffer, summing amplifier, comparator, Instrumentation amplifier.

MODULE 4: Digital or Logic Circuits
Number system, Boolean Algebra, combinational logic design using truth tables; Logic simplification: using Boolean laws, rules, De-Morgan's theorem; by Karnaugh Map; combinational logic modules: Adder, Subtractor, Decoder, Encoder, Multiplexer, De Multiplexer; sequential logic components: Latches & flip-flops; applications of flip-flops, Counter & shift-register.

MODULE 5: Clock and Timing Circuits
Rise time, fall time & duty cycle, Positive-edge triggered & negative-edge triggered circuits, IC-555 timer, a stable & monostable multivibrator realisation using IC-555 timer

MODULE 6: Sensors and Robotic System
Introduction to various types of sensors; The engineering design process, introduction to robotic system.

Text/Reference Books:

1. Applied Electronics by Prof. Tushar and Manisha Jadhav; Everest Publishing House.
2. Digital Fundamentals By Floyd and Jain; Pearson Publication
3. Mechatronics Principles and Applications by Godfrey C. Onwubolu; Elsevier Publication.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181402	**Workshop Theory and Practice-I**	**3-0-2**	**4**

Course Outcomes (CO): At the completion of the course the student will be able:

CO1: To analyze motion transmission in machine-fixture-tool-work (MFTW) system for variation in cutting parameters.

CO2: To identify and apply machines and tools for metal removal to produce various metal parts.

CO3: To analyze and evaluate speed, feed, depth of cut for MFTW system and their effect on machining time.

CO4: To apply, analyze and evaluate production economy by semi-automatic system.

CO5: To apply techniques of sand molding and casting for production of metal parts.

MODULE 1: LATHE

(a) Lathe- Functions, Classification and Specification, Different parts, Drive mechanisms for speed, feed, depth of cut, Taper turning, Machining time. Lathe Accessories and Attachments.

(b) Semi-Automatics: Capstan and Turret lathes – Different parts – Tools —Work and Tool holding devices. Indexing and Bar Feeding Mechanisms. Tool layout and Tool Schedule chart.

MODULE 2: SHAPER, PLANER, SLOTTING & BROACHING OPERATIOS

(a) Shaper – Function, Classification and Specification – Quick

(b) return and feed mechanisms – Shaper operations – Cutting speed and Machining time calculations.

(c) Planer - Function, Specification Table drives and feed mechanism

(d) Broaching: Purpose, broaching tool and machine

(e) Slotting machine: Purpose, slotting tool and machine

MODULE 3: DRILLING

(a) Drilling machines – Classification – specifications – Parts drilling machine – spindle drive mechanisms – tool and work holding devices for operation

(b) Types of drills and tool in hand nomenclature, Drill size and designation of drills.

(c) Deep hole drilling

(d) Introduction to reaming and tapping

MODULE 4: MILLING:

Introduction – Classification – Specifications - Principal parts of a milling machine. Elements of a milling cutter, milling processes – Up-milling – Down milling – Face milling – End milling. Cutting Speed, Feed and Depth of Cut – Machining Time. Indexing and Dividing Head

MODULE 5: GRINDING AND SURFACE FINISHING

Grinding:

Introduction – Kinds of grinding – Grinding Processes – Centreless Grinders – Surface Grinders – Tool and Cutter Grinder – Specifications. Grinding Wheel – Composition and specification. Selection of Grinding Wheel. Dressing, and Truing of grinding Wheel.

Surface Finishing:
Introduction – Classification – Principle and Operations of Lapping, Honing, Super finishing, Polishing, Buffing, Tumbling and Burnishing

MODULE 6: PATTERN MAKING AND FOUNDRY
Pattern making and sand casting – Pattern materials – Types – Pattern allowances. Core prints. Moulding sand – ingredients – classification – sand additives – properties of moulding sand – sand preparation and testing. Green sand mould preparation. Cores and core making – Types of cores.

Text/Reference Books:

1. Elements of Workshop Technology (Vol. I & II) – S.K. Hajra Choudhury and A.K. Hajra Choudhury.
2. A course in Workshop Technology (Vol. I & II) – B.S. Raghuwanshi
3. Manufacturing Technology – P.N. Rao – Tata McGraw Hill
4. Workshop Technology-I – P.K. Sapra and R.K. Kapur- Vikas Publishing
5. Elements of Manufacturing Processes – B.S. Nagendra Parashar and R.K. Mittal – PHI. Introduction to machining Science – G.K. Lal, New Age International Limited

Suggested Practical: Workshop Theory Practice

Course Outcomes: At the completion of the course the student will be able:
CO1: To use proper metal cutting tools and fixtures for producing desired parts.

CO2: To apply various workshop machines for production of parts according to job design.

CO3: To apply the concept of transmission system in a machine tool fixture work (MFTW) system for obtaining desired motion for machine, tool and job.

CO4: To evaluate the effect of machining parameters on quality of machined components.

CO5: To apply techniques of sand molding and casting for production of metal parts.

LATHE MACHINE

1. Demonstration of lathe parts and drive mechanisms.
2. Centering of job by using (i) Scriber (ii) Dial gauge
3. Straight turning, Taper turning, Thread Cutting (External and Internal), Knurling, Grooving, Chamfering in a single job.
4. Parting off the extra material in power saw machine.

PATTERN AND FOUNDRY

1. Making of a split pattern
2. Preparation of green sand mould with the split pattern
3. Casting (Metal- aluminum)

SHAPER AND GRINDER

1. Demonstration of different parts and drives of shaper
2. V – block making
3. Drilling a hole in the V-block
4. Tap internal thread in the drilled hole
5. Grinding of sharp edges.

MILLING MACHINE

1. Demonstration of various parts of a milling machine.
2. Indexing of circular gear blank.
3. Cutting of spur gear and helical gear.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181403	Fluid Mechanics-I	**3-0-0**	**3**

Objective:

i. To provide knowledge on behavior of incompressible fluids both in static as well as in dynamic conditions.
ii. To generate an idea on flow analysis and measurement of incompressible fluid parameters.
iii. To impart knowledge on how to analyze continuity equation, momentum equation, energy equation through better mathematical perspective by vectorial approach

Motivation:

The subject is a very basic subject for mechanical engineering. Knowledge of the subject will help to understand better about hydraulics, marine engineering flow simulation river dynamics and basics of atmospheric science.

Course Outcomes: At the completion of the course the student will be able:

CO1: Define various fluid properties like viscosity, density, specific gravity and various forces acting on body in a static fluid.

CO2: Classify the flow of fluids like steady unsteady, uniform non-uniform, Rotational Irrotational, Laminar and Turbulent and elementary flow in two dimension- source flow, sink flow and doublet.

CO3: Analyse dynamics of fluid flow using Euler's Equation Bernoulli's equation, momentum equation and also perform dimensional analysis.

CO4: Develop the concept of static and stagnation pressure and flow measurement through Venturimeter, pitot tube and orifice meter

CO5: Evaluate fluid friction, shear stress, pressure gradient for steady and laminar flow in a pipe and two parallel plates.

MODULE 1:

Introductions:

Definition of Fluid, Dimension and Units, Concept of Continuum, No slip condition of viscous liquids, Classification of fluids, Properties of fluids, mass density, specific weight, specific gravity, viscosity, compressibility, compressibility, surface tension and vapor pressure.

Pressure and Fluid Statics:

Define Pressure, The Manometer, pressure at a point, other pressure measuring devices, Hydrostatic forces on submerged plane and curved surfaces, Buoyancy, stability of floating and submerged bodies.

MODULE 2:

Kinematics of Fluids:

Lagrangian and Eulerian description of fluid motion, Acceleration field of a fluid, Differential Equation of Mass Conservation, streamline, path line, streakline, stream tube, steady and unsteady flow, uniform and non-uniform flow, Rotational and Irrotational flows, Vorticity, Stream function, Velocity potential function, Flow net.

Elementary Flows in a two dimensional plane:
Uniform flow, Source and Sink, Vortex Flow, Free and Forced Vortex, Doublet, Continuity equation and its analysis based on integral form.

MODULE 3:

Dynamics of Fluid Flow:
Euler's equation of motion, The Bernoulli's equation and its application, General Energy equation and momentum equation, Dynamic forces on plain and curved surfaces due to impingement of liquid jets.

Flow Measurement:
Concept of static and stagnation pressures, Pitot tube and its application, venturimeter, Orificemeter, Hydraulic co-efficient of an Orifice, Factors affecting the Orifice co-efficients.

Dimensional Analysis and its applications
Introduction, Dimensionless numbers and its significance, Fluid flow problems, drag in immersed bodies.

MODULE 4:

Flow through pipes:
Laminar and turbulent flow, Reynolds number, Pressure drop and head loss in pipe, Darcy Weisbach equation, Steady laminar flow through circular pipes, flow between parallel plates, Couette flow

Text/Reference Books:

1. Fluid Mechanics ------ Dr. A. K. Jain.
2. Fluid Mechanics ------- Cengel &Cimbala.
3. Introduction to fluid mechanics and fluid machines------ Som, Biswas and Chakrabarty
4. Fluid Mechanics ------ Dr. J. Lal
5. Fluid Mechanics and machines ----- V. L. Streeter.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181404	**Materials Science**	**3-0-2**	**4**

Course Overview

Materials Science is a very important interdisciplinary course at the undergraduate level. The course includes basic fundamentals of materials science and engineering. The course coverage topics of crystallography and crystal structure determination, dislocations, phase diagrams, heat treatments, oxidation and corrosion, mechanical properties and evaluation, oxidation and corrosion. The Last unit covers a general idea on engineering alloys with their applications.

Selection of materials for various structural applications is an important task for engineers. The growth of science and technology depends on availability of suitable materials. This includes room temperature to high-temperature applications and various environments.. All these applications require different material properties suitable to those conditions. This course provides guidance for selection of material for various applications and to tailor properties of materials according to the requirements. The significance of the course lies on the in-depth knowledge in materials engineering and their selection for manufacturing industries. Prerequisites of the course: UG level physics, chemistry and mathematics.

Course Outcomes

1) Analysis : Determine:-- For a given X-ray diffraction (XRD) pattern for an elemental cubic material, students will be able to index the XRD peaks, determine the crystal structure and lattice parameter.

2) Analysis : Analyze:--For a given binary phase diagram, students will be able to analyze the microstructure and the phases formed during solidification of the alloy.

3) Synthesis : Design:--For obtaining desired material properties in steels, students will able to design and recommend suitable heat treatment process.

4) Analysis : Determine:--For a given material, students will be able to determine the tensile, hardness, impact and fatigue properties.

5) Analysis : Determine:--Students will be able analyze the various lattice imperfections and able to determine critical resolved shear stress (CRSS) for a given slip system.

6) Analysis : Analyze:--Students will be able to analyze the various processes of oxidation and corrosion in metals and alloys and apply suitable techniques to protect them.

MODULE 1:

Brief review of Crystal Structures- Crystal Directions and Planes. The Bragg Law of X-ray diffraction, Powder method of XRD and the crystal structure determination. **(4 Lectures)**

MODULE 2:

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Fracture mechanics: Introduction to Stress intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT) **(12 Lectures)**

MODULE 3:

Alloys: substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Fe-Fe_3C diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron. **(6 Lectures)**

MODULE 4:

Heat treatment of Steel: Annealing and its classifications, tempering, normalising and spheroid sing, isothermal transformation diagrams for Fe-C alloys and microstructure development. TTT diagram, Continuous cooling curves and interpretation of final microstructures and properties-austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening. **(8 Lectures)**

MODULE 5:

Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critical resolved shear stress. Deformation by twinning, Stacking faults, deformation of polycrystalline materials. **(6 Lectures)**

MODULE 6:

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys **(4 Lectures)**

Text/Reference Books:

1. Materials Science and Engineering, V. Raghavan, PHI
2. Mechanical Metallurgy, George E. Dieter, McGraw hill Book Company
3. Materials Science and Engineering, V. Raghavan, PHI
4. Heat Treatment-Principles and Techniques, T.V. Rajan, C.P. Sharma and A. Sharma, Eastern Economy Edition
5. Mechanical Metallurgy, George E. Dieter, McGraw hill Book Company
6. Materials Science and Engineering– R.K. Rajput, S.K. Kataria and Sons

Suggested Practical:

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

CO1: Determine the hardness of metals

CO2: Determine the yield strength, ultimate tensile strength and ductility of metals

CO3: Determine the impact strength of metals

LIST OF EXPERIMENTS

1. Brinell Hardness Test
2. Rockwell Hardness Test
3. Impact (Dynamic) Test (Izod and Charpy Test)
4. Uniaxial Tension Test

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181405	**Mechanics of Materials**	**3-0-0**	**3**

Objective:
The course will impart knowledge of mechanics of deformable solids and different types of stresses and strains developed in deformable solids due to various loads. It will help to understand the mechanical behaviour of deformable solids under different types of loads and stresses. Exposure to energy methods will help to solve a wide variety of engineering problems. Ability to analyze and solve strength related practical problems will be developed.

Motivation:
The knowledge of Mechanics of Materials has wide application in mechanical, civil, industrial and production, aeronautical and aerospace engineering. The subject lays the foundation for other engineering subjects like Machine Design, Theory of Structure, Finite Element Analysis, Fracture Mechanics, etc. Engineering aptitude will be incomplete without the knowledge of the subject.

Course Outcomes (CO): At the completion of the course the student will be able:
CO1: Explain stress-strain relationship for homogeneous and isotropic material under axial, torsional, flexural and combined loads.

CO2: Compute principal stresses and strains and maximum shear stress using analytical and graphical methods.

CO3: Analyze radial, hoop and longitudinal stresses for thick cylinders under external and internal loading and analyze stresses in rotating discs.

CO4: Derive stresses in curved beam and estimate the stresses and deflection of helical spring under axial load.

CO5: Apply energy method to estimate the deflection and rotation of beams under flexural loading.

MODULE 1
Complex stresses and strains: Introduction to Cartesian tensors, derivation of Cauchy relations and equilibrium equations in spherical and polar/cylindrical coordinates, principal stresses and directions, stresses on octahedral planes, stress invariants, plane stress, stresses on oblique planes, Mohr's circle for plane and tri-axial stress system. Analysis of strain components, compatibility relations, strain tensor, principal strains and directions, strain invariants, strain on oblique planes, plane strain, Strain Rosette.

MODULE 2:
Combined stresses: Stresses due to combined bending and torsion of circular shafts.

MODULE 3:
Combined stresses: Stresses due to combined bending and torsion of circular shafts.
Axisymmetric problems: Application to thick cylinders subjected to internal and external pressures, Lame's equation, compound cylinders, and stresses due to shrunk fit, Stresses in rotating discs of uniform strength and uniform thickness

MODULE 4:
Stresses in non-circular cross-sections/curved beams: crane hooks, rings etc
Stresses and deflection of helical springs

MODULE 5:
Computation of slopes and deflection in beams using Double Integration method, Energy method, Theorem of Castigliano, Maxwell Bette reciprocal theorem.

Text/Reference Books:

1. Advanced Mechanics of Solids S Srinath, Tata McGraw Hill
2. Elements of Strength of Materials, S P Timoshenko, CBS Publication
3. Fundamentals of Strength of Materials, D Nag, A Chanda, Wiley India
4. Advanced Mechanics of Solids, L S Srinath, Tata McGraw Hill
5. Fundamentals of Strength of Materials, D Nag, A Chanda, Wiley India
6. Strength of Materials, S S Pathak, Dhanpat Rai Publications
7. Fundamentals of Strength of Materials, D Nag, A Chanda, Wiley India
8. Advanced Mechanics of Solids, L S Srinath, Tata McGraw Hill
9. Strength of Materials, S S Pathak, Dhanpat Rai Publications

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181406	**Environmental Science**	**2-0-0**	**0**

MODULE 1: Environment and Ecology

i. Introduction
ii. Environment and Ecology
iii. Objectives of ecological study
iv. Aspects of Ecology
    a) Autecology
    b) Synecology
v. Ecosystem
    a) Structural and functional attributes of an ecosystem
    b) Food chain and food web
    c) Energy flow
    d) Biogeochemical cycles

MODULE 2: Land: Use and Abuse

i. Land use: Impact of land – use on environmental quality
ii. Land degradation
iii. Control of land degradation
iv. Waste land
v. Wet lands

MODULE 3: Water Pollution

a) Introduction
b) Water quality standards
c) Water pollution
d) Control of water pollution
e) Water pollution legislations
f) Water quality management in Rivers

MODULE 4: Air Pollution

i. Introduction
    a) Air pollution system
    b) Air pollutants
ii. Air pollution laws
iii. Control of air pollution
    a) Source correction method
    b) Pollution control equipment
    c)

MODULE 5: Noise Pollution

i. Introduction
ii. Sources of noise pollution
iii. Effects of noise
    a) Physical effects
    b) Physiological effects
    c) Psychological effects
iv. controls of Noise pollution

Text / Reference Books:

1. Environmental engineering and management by Dr Suresh Dhameja
2. Environmental studies by Dr B.S. Chauhan
3. Environmental science and engineering by Henry and Hence
4. Environmental studies for undergraduate course by Dr Susmitha Baskar
5. Chemistry for environmental engineering and science by Clair Sawyer

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181413	**Fluid Mechanics–I Lab**	**0-0-2**	**1**

Objective:

i. To impart the knowledge of flow measurement
ii. To give an idea of pressure variation of a fluid in a pipe
iii. To give an idea of dynamic behavior of a fluid

Motivation:

Practical measurement of fluid flow rate, pressure, friction in a pipe etc can be done through this laboratory.

Course Outcomes: At the completion of the course the student will be able:

CO1: Investigate pressure variation, fluid behavior and losses along the flow through a circular pipe

CO2: Compare actual and Standard Cavitation Number of a fluid flow and test the validity of Bernoulli's theorem along a convergent divergent section

CO3: Determine co-efficient of discharge co-efficient of contraction and co-efficient of velocity of flow through and flow rate using Rotameter.

CO4: Determine force exerted on curved vanes by impact of jet

CO5: Compare surface profile of a forced vortex.

LIST OF EXPERIMENTS

1. Determination of a Cavitation number
2. Verification of Bernoulli's equation for incompressible flow
3. Determination of Co-efficient of discharge, co-efficient contraction for orifice meter.
4. Determination of surface profile of vortex apparatus
5. Determination of friction losses in pipes.
6. Determination of force exerted on stationary plate by impact of jet
7. Measurement of discharge through rotameter
8. Determination of pressure in a fluid
9. T verify Darcy's law and to find out the coefficient of permeability of the given medium
10. To find the coefficient of velocity of a pitot tube.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181415	**Mechanics of Materials Lab**	**0-0-2**	**1**

Objective:
The laboratory experiments of Mechanics of Materials will impart practical knowledge of mechanics of deformable solids. The students can observe how deformable solids behave under different types of loads and the stresses and strains developed in them. The theoretical knowledge gained can be experimentally verified with practical examples.

Motivation:
Hands on experiments in laboratory to verify the theoretical knowledge make understanding of the subject in a better way. Laboratory experiments impart in-depth understanding and enhance practical knowledge.

Course Outcomes: At completion of the course, the students will able to

CO1: Analyze failure of a given specimen under gradual application of uniaxial tensile load and determine tensile stress, Young's modulus, yield stress, ultimate stress, and percentage elongation.

CO2: Experiment and verify Hook's law, i.e. the relation between stress and strain within elastic limit with the help of a coil spring.

CO3: Compare actual and calculated shear force and bending moment developed in bending of beam under different loads.

CO4: Calculate stiffness of different helical springs in both compression and tension.

LIST OF EXPERIMENTS

1. UNIAXIAL TENSILE TEST
2. VERIFICATION OF HOOK'S LAW
3. BENDING MOMENT EXPERIMENT
4. COMPRESSION AND EXTENSION OF SPRING

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
MECHANICAL ENGINEERING

5th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure

(From Academic Session 2018-19 onwards)

B.Tech 5th Semester: Mechanical Engineering
Semester V/ B.TECH/ME

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	ME181501	Applied Thermodynamics - I	3	0	2	4	30	70
2	ME181502	Machine Design - I	3	0	2	4	30	70
3	ME181503	Mechanisms and Dynamics of Machines	3	0	2	4	30	70
4	ME181504	Heat Transfer - I	3	0	0	3	30	70
5	ME181505	Engineering Inspection and Metrology	3	0	0	3	30	70
6	HS181506	Engineering Economics	3	0	0	3	30	70
Practical								
1	ME181514	Heat Transfer – I Lab	0	0	2	1	15	35
2	ME181515	Engineering Inspection and Metrology Lab	0	0	2	1	15	35
3	SI181521	Internship-II (SAI-Academia)	0	0	0	1	-	100
TOTAL			18	0	10	**24**	**210**	**590**
Total Contact Hours per week: 28								
Total Credits: 24								

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181501	**Applied Thermodynamics - I**	**3-0-2**	**4**

Course Outcomes (CO): On successful completion of this course the student should be able to:
CO1: Apply the various thermodynamic laws and properties of steam for suitable applications in a steam power plant.
CO2: Analyse the Thermodynamic processes involved in the various components of a steam generating plant.
CO3: Evaluate the performance of steam power cycle and select suitable modified methods to improve the efficiency of power cycle.
CO4: Compare the components of a power plant like boiler, nozzle, turbine and condensers in terms of their advantages and disadvantages for selection in industrial applications.
CO5: Explain the concepts of Availability and Irreversibility under various thermodynamic flow systems.

MODULE 1: Availability
Available and unavailable energy, Available energy referred to a cycle, Availability in non-flow or closed system (Non-cyclic), Availability of steady-flow systems, Helmohltz and Gibb's functions, Irreversibility and loss in availability, Effectiveness.

MODULE 2: Boiler
Classification of boilers, mountings, accessories, evaporation capacity, equivalent evaporation, boiler efficiency, selection of a boiler, boiler feed water treatment and boiler troubles.

MODULE 3: Basic Steam Power Cycles
Carnot and Rankine cycles, Modified Rankine cycle, Regenerative and Reheat cycles.

MODULE 4: Steam Nozzles
Expansion of steam through nozzles, velocity and pressure variation in nozzles, Critical pressure ratio, mass flow rate and maximum mass flow rate, Representation of heat drop in nozzles in Mollier diagram, Nozzle efficiency.

MODULE 5: Steam Turbines
Classification, Flow of steam through impulse and reaction turbines, Velocity diagrams, Reheating, Bleeding, Reheat factor, Compounding and governing of steam turbines, Back pressure turbines, Pass out turbines.

MODULE 6: Steam Condensers
Function of steam condenser, Elements of a condenser plant, vacuum production, Delton's law of partial pressure, Classification of condensers, Sources of air leakage in condensers and their effects, Removal of air from the condesers, Vacuum efficiency and condenser efficiency, Determination of cooling water, Cooling towers and cooling ponds.

Textbooks/ Reference Books:

1. A course in thermodynamics and heat engines by Domkundwar, Kothendaraman, Khajuria and Arora, Dhanpat Rai and Sons.
2. Thermal Engineering by Er. R.K.Rajput, Laxmi Publications.
3. Elements of heat engines by Patel, Karamchandani
4. A text book of thermal engineering by Khurmi, Gupta, K Chand Publications.
5. Applied Thermodynamics by P.K.Nag, Mc Graw Hill Education (India) Pvt Ltd.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181502	Machine Design - I	3-0-2	4

Course Outcomes: On successful completion of the course, the student will be able to:

CO1. Describe the design process, material selection, calculation of stresses and stress concentrations under variable loading. Know different types of Mechanical Failures, different Modes of failure and different theories of failure.

CO2. Design and Analyze bolted joints, standardization, Design different types of riveted joints for various Engineering applications like structural joints, boiler joints etc, Design various types of Welded Joints

CO3. Design solid and hollow shafts for different design considerations, Design of Cotter and Knuckle joints for Alternating/Tensile loads

CO4. Differentiate between rigid and flexible couplings, Design Rigid Couplings and checks against failure,

CO5. Design Belt Drive, Rope Drive and Chain Drive, Applications of these drives in Industry

MODULE 1:
Introduction, General considerations and procedure for designing, types of Loads, Designed stress and factor of safety, stress concentration, selection of materials, codes for design-BIS codes, Modes of Failure, Failure theories, Fits and Tolerance.

MODULE 2: Joints
a) Detachable joints: Design of threaded fasteners, thread forms and threaded fastener types and materials, bold tightening and initial tension, Power screws.
b) Permanent Joints: Design of Riveted joints and welded joints – eccentric loading.

MODULE 3: Shafting
Design of shaft subjected to bending, torsion, axial and combined loading
Keys, Cotter and Knuckle joint

MODULE 4: Coupling
Rigid and Flexible coupling.

MODULE 5: Power Transmission Elements:
Belt and Chain Drives, design of Flat and V-belts.

Textbooks/ Reference Books:

1. Machine Design by Black and Adams (TMH)
2. Design of machine elements by M F Spott
3. Design of machine elements by B V Bhandari (TMH)
4. Machine Design by Hall
5. Machine Design by Khurmi and Gupta
6. Machine Design by Bahl and Goel
7. 7. Machine Design by Shigley

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181503	**Mechanisms and Dynamics of Machines**	**3-0-2**	**4**

Course Outcomes (COs) are:

CO1: To illustrate Kinematic analysis of plane motion graphically and analytically and to draw velocity and acceleration diagram; to understand the concept of Coriolis acceleration used in solving problems in kinematics.

CO2: To synthesize mechanisms to generate the desired motions by combination of different machine elements using analytical and graphical approaches.

CO3: To understand different types of mechanisms used in engineering applications and their working principles.

CO4: To estimate gyroscopic action in certain machine elements using principle of gyroscope and their practical applications.

CO5: To analyze balancing of rotating and reciprocating masses, single and multi-cylinder engines, importance of firing order and study of balancing instruments

MODULE 1: Kinematic Analysis of Plane Motion

Velocity diagram, Acceleration diagram, Coriolis component of acceleration, Analytical method of kinematic analysis.

MODULE 2: Kinematic Synthesis of Linkages

Introduction, number synthesis, basic features, analytical methods, graphical methods.

MODULE 3: Mechanisms

Mechanism, Mobility, Inversion, Test for 4 bar mechanism by Grashoff's law, Straight line mechanism, Oscillatory mechanism, Quick return mechanism, Steering mechanism, Spatial mechanism – Hook's joints.

MODULE 4: Gyroscopic Action in Machines

Gyroscopic action and force, method of analysis, Gyroscopic action in certain machine elements, use of gyroscopic principles in instruments.

MODULE 5: Balancing

Balancing of rotating masses, two plane balancing, balancing of reciprocating masses, Graphical solution, balancing of single cylinder and multi-cylinder engines, firing order, Balancing of rotors, Field balancing, Balancing instruments.

Textbooks/ Reference Books:

1. Theory of Machines: Kinematics and Dynamics by Sadhu Singh, Pearson
2. Theory of Machines by V P Singh, Dhanpat Rai & Co
3. Theory of Machine By Rattan, Tata McGraw Hill

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181504	**Heat Transfer - I**	**3-0-0**	**3**

Course Outcomes: At the completion of the course the student will be able:
CO1: Classify the various modes of heat transfer processes and discuss their applications.
CO2: Define various terms related to heat and mass transfer specifically Diffusion.
CO3: Discuss the mechanisms of heat transfer under steady and transient conditions and describe various examples.
CO4: Choose suitable methodology for solving wide variety of practical heat transfer problems involving Conduction and Radiation heat transfer.
CO5: Design various heat transfer systems such as Fins, Radiation shields and define related parameters.

MODULE 1: Introduction: Concept of Modes of Heat Transfer

Conduction Heat Transfer: General 3-D differential equation for heat conduction, Boundary conditions and their types.

MODULE 2: One Dimensional Steady State Heat Conduction

System with or without heat generation: slab, cylinder, sphere, Concept of thermal resistance and electrical analogy, Variable thermal resistance and electrical analogy, Composite systems: slab, co-axial cylinder, concentric sphere, Critical radius of insulation, Fins.

One Dimensional Unsteady State Heat Conduction: Lumped system analysis, Response time of a temperature measuring instrument, Mixed boundary condition.

MODULE 3: Radiation Heat Transfer

Nature of thermal radiation, emissive power, Absorption, Reflection and Transmission, Concept of a black body, Intensity of radiation, Laws of black body radiation, Radiation to and from real surfaces.

MODULE 4: Radiative Heat Exchange Between Surfaces

Radiation between two black bodies, Radiation shape factor (View factor) and its properties. Shape factors for different geometries, Radiation between two infinite parallel places, Radiation between two infinitely long concentric cylinders, Radiation between grey bodies, Electric network analogy for thermal radiation, Radiation shields, Radiation combined with convection.

MODULE 5: Diffusion Mass Transfer

Concentrations, Velocities and Fluxes, Fick's law of diffusion, the diffusion co-efficient, Species conservation equation and the boundary equation, Steady state molecular diffusion.

Textbooks/ Reference Books:

1. A basic approach to heat transfer – by M N Ožišik, McGow Hills.
2. Fundamentals for heat transfer – by Sachdeva, Wiley Eastern.
3. Heat transfer, by P.S. Ghoshdastidar, Oxford University Press

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181505	**Engineering Inspection and Metrology**	**3-0-0**	**3**

Course Outcomes (CO): At the completion of the course the student will be able:
CO1: To apply proper instruments for dimensional measurements according to level of precision.
CO2: To apply necessary standards for obtaining desired fit and design appropriate limit gauges.
CO3: To develop analytical and experimental techniques for precise measurement of thread and gear parameters.
CO4: To design appropriate control charts for statistical process control.
CO5: To estimate texture of machined surface by stylus equipment and optical interferometry.

MODULE 1: Introductory Concept
(a) Meaning of engineering metrology. Precision, Accuracy, Sources of errors in measurement.
(b) Meaning of engineering inspection, types of inspection, merit/demerit of 100% inspection.
(c) Sampling inspection – Representative sample.
Standards of measurement and sub-division of standards.

MODULE 2: Statistical Process Control
(a) Dimensional variations during manufacture, Chance causes and Assignable causes.
(b) Control chart and its significance in statistical process control, Meaning of process under statistical control. Examples of control charts.
(c) Computer implementation of control charts.

MODULE 3: Tolerance, Limits of Size and Fits
(a) Concept of tolerance, allowance and clearance
(b) Natural tolerance limits, Process capability and Specification limits.
(c) Hole and shaft basis systems of specifying limits of size and tolerances.
(d) Indian Standard for fits and tolerances.
(e) Limit gauges – Meaning of gauge, Taylor's principle of limit gauging, Design of hole/ring gauge and plug gauge and their use, Type I and Type II statistical errors.
(f) Interchangeability – its importance in production, techniques of achieving interchangeability during manufacture of industrial products.
Comparators – Features of comparators, classification of comparators, different comparators and their uses in mass production.

MODULE 4: Tool Room Measuring Instruments
Vernier Calliper, Micrometer screw gauge, Height gauge, Depth gauge, V blocks, Straight edges, Radius gauge, Feeler gauge, Wire gauge, Thread pitch gauge, Bevel protractor, Combination set, Bore gauge, Sine bar and slip gauges, Dial indicator with magnetic base, Surface plate, Profile projector (PP), Tool maker's microscope (TMM), Diameter measuring machine (DMM) and Coordinate measuring machine (CMM): Types of CMM, Role of CMM, and applications of CMM.

MODULE 5: Measurement of Screw Threads

(a) Parameters for measurement of screw threads.
(b) Measurement of various parameters of screw thread such as diameter, thread angle, effective diameter and pitch.
(c) Use of screw thread micrometer and Thread pitch gauge
(d) One wire, Two wire and Three wire methods.
(e) Use of TMM, PP, DMM in thread measurement.

MODULE 6: Measurement of Gears

(a) Profile of gear tooth and Involute function.
(b) Spur gear measurements by functional and analytical tests. Parkson gear tester.
(c) Measurement of tooth thickness – chordal thickness method, constant chord method, base tangent method.
(d) Check for pitch circle diameter and tooth spacing.

MODULE 7: Surface Texture

(a) Meaning of surface texture, Elements of surface texture.
(b) Meaning of roughness and Waviness.
(c) Roughness width cut-off (Sampling length) and its significance
(d) Representation of surface roughness.
(e) Procedure of estimation of surface roughness.
(f) Measurement of surface roughness by stylus equipment.

MODULE 8: Interferometry

(a) Condition for constructive and destructive interference of monochromatic light waves.
(b) Sources of monochromatic light for lab use.
(c) Use of optical flat.
(d) Principle of Gauge length interferometer and Laser interferometer.

MODULE 9: Alignment Testing

(a) Optical methods for alignment testing
(b) Laser alignment testing.
(c) Alignment tests on machine tools

Textbooks:

1. Metrology and Measurement, Anand Bewoor, Vinay A. Kulkarni, TMH
2. Engineering metrology – M Mahajan
3. Engineering Metrology – R K Jain
4. Dimensional metrology – M K Khare and S Vajpayee, OXFORD-IBH Publishers

Reference Books:

1. Handbook of industrial metrology – ASTME publication
2. Engineering Metrology – K J Hume, Published by Macdonald & Co.(1968)
3. Practical Engineering Metrology – K W B Sharp, Sir Isaac Pitman & Sons
4. Engineering Precision measurements – A W Judge, Chapman and Hall publishing (1957)
5. Dimensional Metrology – L Miller,Edward Arnold publishing Co
6. Precision Measurements – Jack Johnson – Pitman publishing Co.

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181506	**Engineering Economics**	**3-0-0**	**3**

Course Outcomes (COs):

The students will be able to

1. Acquire knowledge about economics its nature, scope and importance.
2. Understand the economic laws, principles, and theories and their relevance in present day situation.
3. Develop the ability of critical thinking to meet the challenges at the national and global problems.
4. Apply knowledge in finding out socio-economic problems and appropriate measures to deal with them.
5. Equip students with vital knowledge to run government and non-government institutions and bodies.
6. Assemble knowledge which is vital for industry and research and evolve proper policy for economic development.

MODULE 1: Introduction to Economics (3 Lectures)
Meaning and Definition of Economics, Nature and Scope of Economics, Concept of Micro and Macro Economics.

MODULE 2: Utility Analysis (3 Lectures)
Meaning of Utility, Utility Function, Consumers Equilibrium, Concept of Indifference Curve, properties of Indifference Curve, Equilibrium under Indifference Curve.

MODULE 3: Demand and Supply Analysis (4 Lectures)
Law of Demand, Demand Function, Elasticity of Demand, Types of Elasticity of Demand, Measurement of Elasticity of Demand, Demand Forecasting, , Law of Supply, Supply Function.

MODULE 4: Revenue, Production & Cost Analysis (4 Lectures)
Average, Marginal and Total Revenue, Revenue Function, Average, Marginal and Total Cost, Cost Function, Short and Long Run Cost Curves. Break Even Point, Managerial Uses of Cost Function, Cobb Douglas Production Function.

MODULE 5 : Market Structure (4 Lectures)
Concept of Market, Price-Output Determination under Perfect Competition, Monopoly Market and Monopolistic Competition.

MODULE 6 : Money, Banking and National Income (8 Lectures)
Definition of Money, Function of Money, Index Numbers, Construction of Index Numbers, value of Money, Causes of Inflation, Functions of Commercial and central bank, Central bank and its monetary policy, Money Market and Capital Market, Functions of Stock exchange, Concept of National Income, Measurement of National Income, Concept of Investment.

MODULE 7: Introduction to Environmental Economics (5 Lectures)
Concept of Environmental Economics, Cost -Benefit Analysis, Social Cost, Externalities, Concept of Pareto Equilibrium, Externality, Market Failure.

MODULE 8: Public Finance (3 Lectures)
Introduction to Public Finance, Concept of Budget, Types of Budget, Budget Receipts, Concept of Goods and services Tax (GST).

Textbooks/Reference Books:

1. Managerial Economics by V. Agarwal: Pearson Pvt. Limited, New Delhi.
2. Engineering Economics by Dr. A. Ahmed & G. Begum: Chandra prakash, Guwahati
3. Principles of Engineering Economics with Application by Dr. Z. A. Khan, A. N. Siddiquee, B. Kumar, M. H. Abidi: Cambridge University Press.
4. Public Finance and Public Policy by Dr. R. K Choudhury: Kalayani publishers .
5. Quantitative Methods for Economics by R. Veerachamy: New Age International Publication Ltd.
6. Micro and Macro Economics by Dr. M. L. Seth: Educational Publishers , Agra -3
7. A Koutsoyiannis: Modern Microeconomics
8. Environmental Economics by R. N. Bhattacharya: Oxford Publication.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181514	**Heat Transfer – I Lab**	**0-0-2**	**1**

Course Outcomes: After successful completion of the course, the student will be able to:

CO1: Estimate physical properties like thermal conductivity of different liquids and solids and compare its variation.

CO2: Demonstrate the pin-fin apparatus, draw the temperature curve and predict its efficiency and deduce the practical applications of a fin.

CO3: Conduct experimental research in radiation heat transfer and determine various related parameters specifically Stefan-Boltzmann constant and Emissivity of solid surface.

List of Experiments

Experiments on Conduction

1. Determination of thermal conductivity of guarded hot plate
2. Determination of thermal conductivity of liquid
3. Determination of thermal conductivity of insulating powder
4. Study of temperature distribution in a pin-fin
5. Experimentation with unsteady heat transfer apparatus

Experiments on Radiation

1. Determination of stefan boltzmann constant
2. Determination of emissivity of the test plate surface at various temperatures

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181515	**Engineering Inspection and Metrology Lab**	**0-0-2**	**1**

Course Outcomes (CO): At the completion of the course the student will be able:

CO1: To apply proper instruments for dimensional measurement according to level of precision.

CO2: To utilize setting gauge for calibration of instrument during precision measurement.

CO3: To apply necessary tolerances on limit gauges for quality control.

CO4: To compare results of theoretical analysis with practical measurement in threads and gears.

CO5: To estimate precisely surface roughness of machined surface texture

LIST OF EXPERIMENTS

(*to select experiments from the list and add similar experiments to address the COs*)

1. To use vernier caliper and standard setting gauge for precision measurement.
2. To use micrometer screw gauge to measure major diameter and minor diameter of thread
3. To measure the height of an object by using height gauge
4. To measure the depth of a hollow cylinder by using depth gauge
5. To measure the internal diameter of a hollow cylinder by using bore gauge
6. To use feeler gauge to set clearance between mating parts
7. To use radius gauge to check the radius of a fillet
8. To use plug gauge/ring gauge/snap gauge as GO/NOGO gauge
9. To use dial indicator as comparator
10. To use thread pitch gauge to estimate the pitch of screw thread
11. To use screw thread micrometer to estimate effective diameter of screw thread
12. To use standard wire method to estimate effective diameter of screw thread
13. To use profile projector in measuring linear and angular dimensions of engineering components
14. To use Tool Maker's Microscope for linear and angular measurements
15. To use bevel protractor for angular measurement
16. To use gear tooth vernier caliper in the measurement of spur gear parameters
17. To estimate roughness of a machined surface by surface roughness testing instrument.

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
MECHANICAL ENGINEERING

6th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure

(From Academic Session 2018-19 onwards)

B.Tech 6th Semester: Mechanical Engineering
Semester VI/ B.TECH/ME

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	ME181601	Machine Design-II	3	0	2	4	30	70
2	ME181602	Fluid Mechanics-II	3	0	0	3	30	70
3	ME181603	Mechanical Measurements and Instrumentation	3	0	0	3	30	70
4	ME181604	Workshop Theory and Practice-II	3	0	2	4	30	70
5	ME181605	Heat Transfer-II	3	0	0	3	30	70
6	HS181606	Accountancy	2	0	0	2	30	70
Practical								
1	ME181612	Fluid Mechanics-II Lab	0	0	2	1	15	35
2	ME181613	Mechanical Measurements and Instrumentation Lab	0	0	2	1	15	35
3	ME181615	Heat Transfer-II Lab	0	0	2	1	15	35
Total			**17**	**0**	**10**	**22**	**225**	**525**
Total Contact Hours per week: 27								
Total Credits: 22								

N.B. 4-6 weeks Mandatory Industry Internship need to be done in the 6th semester break and the report is to be submitted and evaluated in 7th semester

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181601	**Machine Design-II**	**3-0-2**	**4**

Course Outcomes (COs): On successful completion of this course the student should be able to:
CO1: Identify the modes of fatigue failure in materials in cases of axial, torsional, flexural and combined loading conditions with stress concentration criteria
CO2: Distinguish between cases of static and dynamic loading conditions to test the theories of failure in design of simple mechanical elements like plates, bars, beams and shafts
CO3: Design gears, springs by selecting and analyzing engineering materials and considering design criterions of failure under static and dynamic loading conditions using design data hand book(s)
CO4: Utilize the principles of tribology to design sliding contact bearing and select antifriction-bearings under static and dynamic loading conditions using design data hand book(s)
CO5: Design and analyze brakes and clutches under the consideration of power transmission using design data hand book(s)

MODULE 1: **(10 Lectures)**
Design against static load
Different types of loads and stresses- Review
Design against fluctuating load
Stress concentration, fluctuating stresses, Fatigue failure, endurance limit, Notch sensitivity, cumulative damage in fatigue, Soderberg and Goodman Diagrams, Fatigue design under combined stresses

MODULE 2: **(10 Lectures)**
Design of Mechanical Springs – helical spring, Gears: Spur and Helical gear

MODULE 3: **(10 Lectures)**
Design of Friction clutches – single and multidisc clutch, cone clutch, Brakes – Disc, cone, band and internal expanding shoes

MODULE 4: **(10 Lectures)**
Tribology, Design of Bearings – radial and Thrust journal bearings, Selection of Rolling Contact Bearings

Textbooks/ Reference Books:

1. Machine Design by Black and Adams (TMH)
2. Design of machine elements by M F Spott
3. Design of machine elements by B V Bhandari (TMH)
4. Machine Design by Hall
5. Machine Design by Khurmi and Gupta
6. Machine Design by Bahl and Goel
7. Machine Design by Shigley
8. Design Data Handbook: Mahadevan and Reddy

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181602	Fluid Mechanics-II	3-0-0	3

Course Outcomes (COs): At the completion of the course the student will be able:

CO1: To familiarize with behaviour of compressible gas flow and to understand the difference between subsonic and supersonic flow

CO2: Illustrate the effect of Mach number on wave pattern, and do analysis for Fanno flow, Rayleigh flow and isothermal flow

CO3: Determine integral thicknesses, wall shear stresses, and skin friction coefficient using the concepts of viscous boundary layers and the momentum integral

CO4: Justify the cause of boundary layer separation in viscous and turbulent flows, deduce velocity distribution, shear velocity, and intensity in turbulent flows and derive the governing equations for the respective flows

CO5: Solve turbulent fluid flow problems with the application of turbulent theories and boundary conditions, differentiate between hydraulically smooth and rough boundaries

MODULE 1: Compressible Flow

Introduction to Compressible Flow, Propagation of elastic waves, wave pattern under varying Mach number, one dimensional steady Isentropic flow, Irreversible discontinuity in supersonic flow, Shock Waves-Normal shock, Impossibility of shock in subsonic flow, Moving normal shock waves, Fanno flow, Rayleigh flow, Isothermal flow

MODULE 2: Viscous Flow

Characteristics of laminar flow, governing equation, Boundary layer equation, Blasius flow over flat plate, Wall shear and boundary layer thickness, Momentum integral equation for boundary layer, Separation of boundary layer, Control of boundary layer separation, Mechanics of boundary layer transition, Several events of transition, Form drag and skin friction drag

MODULE 3: Turbulent Flow

Characteristics, Classification, Theories of Turbulent, Mean Motion and Fluctuations, derivation of Governing equation for turbulent flow, boundary conditions, Prandtl's mixing length, universal velocity distribution Law and Friction factor in Duct flow for very large Reynold Numbers, velocity distribution, shear velocity, hydraulically smooth and rough boundaries, velocity distribution in rough pipes, Nikuradse's Experiment on artificially roughened pipes, Karman-Prandtl resistance equation

Textbooks/ Reference Books:

1. Fluid Mechanics (Tata McGraw Hill) -------- V. L. Steeter
2. Fluid Mechanics (Prentice Hall India) ------- A. Mohanti
3. Fluid Mechanics (ELBS) ------- Massey
4. Gas Dynamics (PHI) ------ E. Rathakrishnan
5. Introduction to Fluid Mechanics and Fluid Machines ----S K Som & G Biswas

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181603	**Mechanical Measurements and Instrumentation**	**3-0-0**	**3**

Course Outcomes (COs):

This course aims to improve students understanding of the concepts, principles, problems, and practices of mechanical measurement systems. After completing this course, students should be able to:

CO1: Apply the principles of static and dynamic characteristics of the instruments for their calibration
CO2: Apply transducers and sensors for measuring mechanical parameters
CO3: Apply modulation and demodulation for mechanical signals and different conversion techniques
CO4: Apply the concept of measurement and identify the errors involved in the control systems
CO5: Select and apply measuring instruments for industrial manufacturing systems

MODULE 1: General Concept of Measurement and Instrumentation (2 Lectures)

Definition of Measurement and Instrumentation, Precision, Accuracy in measurements, Sources of errors in measurement. Standards of measurement and sub-division of standards

MODULE 2: Static and Dynamic Characteristics of Instruments (4 Lectures)

Static and dynamic characteristics of instruments and instrumentation system, Linear and non-linear systems, Electrical networks, Mechanical systems, Analogous systems, Thermal systems, First and second order systems

MODULE 3: Primary Sensing Elements and Transducers (8 Lectures)

(i) Introduction
(ii) Mechanical Devices as Primary Detectors
(iii) Mechanical Spring Devices: Cantilever, Helical Spring, Spiral Spring, Proving Rings, Load cells, Spring Flexure Pivot
(iv) Pressure sensitive primary devices: Bourdon Tubes, Diaphragms, Bellows
(v) Classifications of transducers: Primary and Secondary transducers, Passive and Active Transducers, Analog and Digital transducers, Transducers and Inverse transducers
(vi) Transducers for linear displacement measurement: Resistive transducers, Potentiometers, Variable inductance transducers, Linear variable differential transducers (LVDT), Capacitive transducers, Piezo electric transducers, Rosettes

MODULE 4: Strain Gauges (3 Lectures)

Measurement of strain and applications of strain gauges

MODULE 5: Measurement of Pressure with Secondary Transducers (2 Lectures)

(i) Resistive, (ii) Inductive, (iii) Capacitive, (iv) Piezo-electric transducers

MODULE 6: Measurement of Torque (3 Lectures)

(i) Strain gauges, (ii) Torque meters, (iii) Inductive torque transducers, (iv) Digital method, (v) Magneto-stricture transducers

MODULE 7: Measurement of Angular Velocity (2 Lectures)

(i) AC and DC tachometer generators (ii) Drag cup rotor AC (iii) Photo-electric tachometer

(iv) Stroboscopic methods

MODULE 8: Measurement of Vibrations (2 Lectures)
Seismic transducers (ii) LVDT accelerometers (iii) Piezo-electric accelerometers

MODULE 9: Measurement of Temperature (2 Lectures)
(i) Platinum resistance thermometers (ii) Thermocouples (iii) Thermistors (iv) Optical pyrometers

MODULE 10: Measurement of Flow (2 Lectures)
(i) Turbine meter (ii) Electro-magnetic flowmeter (iii) Hot wire anemometer

MODULE 11: Miscellaneous Measurements (6 Lectures)
Measurement of sound using microphone, Cathode ray oscilloscope: Observation of wave forms, measurement of voltage and current, Lissajous patterns for measurements of phase and frequency

MODULE 12: Display Devices and Recorders (4 Lectures)
Electrical Indicating Instruments, Analog Ammeters and Voltmeters, Strip chart recorders, X-Y recorders, Ultra-violet recorders, Magnetic tape recorders

Textbooks/ Reference Books:

1. Mechanical Measurement and Instrumentation by Er R.K Rajput. S.K.Kataria & sons
2. Mechanical Measurement and Instrumentation, A.K Sawhney
3. Doebelin's Measurement System Ernest O Doebelin/Dhanesh N Manik Mc Graw Hill Education

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181604	**Workshop Theory and Practice-II**	**3-0-2**	**4**

THEORY

Course Outcomes (COs): At the completion of the course the students will be able to:

CO1: Choose a suitable welding process for a given application under specific conditions demonstrating an understanding of the principle, advantages and limitations of several welding and allied processes
CO2: Predict chip characteristics, estimate tool life and evaluate cutting forces for known process parameters in machining with single point cutting tool specified in ASA or ORS and justify changes in tool design and process parameters to improve tool life by reducing tool wear and cutting forces
CO3: Distinguish between Jigs and Fixtures and select the appropriate work holding device for a given manufacturing operation
CO4: Justify the selection of additive manufacturing (AM) over conventional manufacturing for a given application and choose a suitable AM technology based on consideration of material and product design
CO5: Classify and compare non-conventional machining processes and use this knowledge to identify suitable technology for a given machining application

MODULE 1: Welding and Allied Processes

(a) Overview of Welding technology and its classification
(b) Oxyfuel gas welding: Oxy-acetylene welding – welding equipment – Types of flames – Alternative fuels – Oxyfuel gas cutting
(c) Non-consumable electrode arc welding: Processes viz. GTAW, PAW, – Principle – Power source – Polarity – Equipment – Electrodes – Applications; Arc Cutting
(d) Consumable electrode arc welding: Processes viz. SMAW, GMAW, FCAW, SAW– Principle – Power source – Polarity – Forces on droplet and droplet transfer across the arc – Equipment – Electrodes – Applications
(e) Resistance welding: Processes – Principle – Applications
(f) Soldering and Brazing
(g) High energy beam welding: Laser Beam and Electron Beam
(h) Solid State Welding: Friction Welding; Friction Stir Welding; Explosive Welding; Ultrasonic Welding
(i) Weldability and its factors
(j) Inspection and testing of welds

MODULE 2: Cutting Tool Specification and Mechanics

(a) Single point cutting tools – Reference planes – System of axes. Tool specifications – ASA & ORS systems
(b) Mechanics of metal cutting:Mechanism of chip formation – Type of chips. Orthogonal and oblique machining, Chip thickness ratio and velocity relationship, Stress, Strain and Strain rate, Merchant Theory of metal cutting, Measurement of cutting forces
(c) Cutting variables and factors affecting them, Selection of tool angles

(d) Tool wears and Tool life – Basic causes – Progressive tool wears – Tool life – Variables affecting tool life – Specifications and criteria for tool life. Machinability – Factors – Criterion
(e) Tool materials and Cutting Fluids

MODULE 3: JIGS and Fixtures
Introduction – Elements of Jigs and Fixtures – Principle of Location – Locating Methods and Devices – Design Principle for Location. Clamping – Principles for Clamping – Clamping Devices. Indexing Jigs and Fixtures – Indexing devices. Fool- Proofing

MODULE 4: Additive Manufacturing (AM)
Overview – Basic principle need and advantages of AM – Comparison of conventional manufacturing and AM – Procedure of product development in AM – Classification of AM processes – Materials used, applications and challenges of AM technologies viz. 3D-printing, Stereolithography (SLA), Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), Selective Deposition Lamination (SDL), Ultrasonic consolidation, Selective Laser Sintering (SLS), Laser Engineered Net Shaping (LENS), Electron Beam Free Form Fabrication (EBFFF), Electron Beam Melting (EBM), Arc based AM: Plasma transferred arc, Tungsten inert gas and Metal inert gas

MODULE 5: Non-Conventional Machining
Need for Non-Conventional Machining. Principles of operation, Machine setups, Applications, Merits and Demerits of – (a) Abrasive Jet Machining, (b) Ultrasonic Machining, (c) Electrochemical Machining, (d) Electro-discharge Machining, (e) Laser Beam Machining, (f) Electron Beam Machining. Comparative study of the above processes

PRACTICAL

Course Outcomes (COs): At the completion of the course the students will be able to:
CO1: List the general safety precautions required in different shop floors and point out any deficiencies in a given setup
CO2: Identify the general tools and equipment used in machine shop and welding shop
CO3: Prepare simple butt joints using gas welding or arc welding and lap spot welds using resistance spot welding
CO4: Experiment to determine suitable process parameters to improve surface finish for machining mild steel using single point cutting tool
CO5: Plan the required operations involving machining and welding to produce a simple product for a given job design

MODULE 1: Welding and Allied Processes
(a) Demonstration of arc welding equipment, tools and personal protective equipment (PPE)
(b) Study of OAW equipment, gas flame types, Types of Torches and Gas welding (OAW) of MS flat after edge preparation
(c) Study of SMAW set up and weld MS plate
(d) Study of GTAW set up and welding of MS plate
(e) Study of GMAW welding set up and welding of MS plate
(f) Resistance spot welding of MS sheet
(g) Demonstration of Friction Stir Welding

MODULE 2: Cutting Tool Specification and Mechanics

(a) Prepare a single point cutting tool by grinding from square rod blank
(b) Study the effect of speed, feed, DOC and environment on finish and chip pattern

MODULE 3: JIGS and Fixtures

Demonstrate work holding devices in the workshop and machine tools

MODULE 4: Additive Manufacturing (AM)

Demonstration of an additive manufacturing set up

MODULE 5: Non-Conventional Machining

Demonstration of equipment in non-conventional machining shop

Textbooks/ Reference Books:

1. Elements of Workshop Technology (Vol. I & II) – S.K. Hajra Coudhury and A.K. Hajra Choudhury.
2. A course in Workshop Technology (Vol. I & II) – B.S. Raghuwanshi
3. Manufacturing Technology – P.N. Rao – Tata McGraw Hill
4. Introduction to Machining Science – G.K. Lal, New Age International Limited
5. Jigs and Fixtures – P.H. Joshi, Tata McGraw Hill
6. Manufacturing Science – Amitabha Ghosh and Asok Kumar Mallick, East West Press
7. Non-Conventional Machining – P.K. Mishra, Narosa Publishing House.
8. Fundamentals of modern manufacturing: materials, processes and systems – Mikell P. Groover, John Wiley & Sons, Inc.
9. Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing – I Gibson, D W Rosen and B Stucker, Springer, 2010

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181605	Heat Transfer-II	3-0-0	3

Course Outcomes (COs): At the completion of the course the student will be able:

CO1: Classify the various types of Convective heat transfer problems and discuss their applications

CO2: Apply dimensional analysis in convective heat and mass transfer to derive empirical equations

CO3: Compare different types of boundary layers formed in various flow problems and evaluate various parameters of hydrodynamic and thermal boundary layers

CO4: Design different types of heat exchangers by deducing sizing and thermal analysis methods and analyze two-phase flow problems

CO5: Evaluate the heat transfer rate in forced and free convection modes using corresponding empirical correlations

MODULE 1: Fundamentals of Convective Heat Transfer

Introduction; The basic equations, the convective heat transfer co-efficient.

Forced convective systems: Forced convection over a flat-plate (External flow), Heat transfer and temperature distribution for flow between parallel plates, Forced convection in circular tubes (Internal flow)

MODULE 2: Free Convection

Laminar boundary layer equations of free convection on a vertical flat-plate, concept of Grashoff number, Empirical correlations for vertical plates, horizontal plates, inclined surface, vertical and horizontal cylinders, spheres

MODULE 3: Heat Exchanger Analysis & Design

Types; Overall heat transfer co-efficient. Fouling factor, LMTD methods of analysis, Effectiveness – NTU method. Pressure drop and pumping power, Aspects of design.

Double pipe heat exchanger Shell and tube heat exchanger; Condensers, Optimization of heat exchangers

MODULE 4: Boiling and Condensation

Boiling heat transfer phenomena, Boiling correlations, Laminar film-wise condensation on a vertical plate.

Flow Measurement Concept of static and stagnation pressures, application of Pitot tube in Flow Measurements, Pitot Static tube, Hot wire anemometer, Venturimeter, Loss of head in a venturimeter, Orificemeter and its classification, the phenomenon of jet contractions, Hydraulic co-efficient of an Orifice, Factors affecting the Orifice co-efficients

MODULE 5: Convective Mass Transfer

Convective mass transfer co-efficient; the concentration boundary layer. Analogy between momentum, heat and mass transfer, Convective mass transfer correlation, evaporation of water into air.

Dimensional analysis: Application to free and forced convection; application to convective mass transfer

Reference Books:

1. A basic approach to heat transfer – by M N Ožišik, McGraw Hills
2. Fundamentals for heat transfer – by Sachdeva, Wiley Eastern
3. Heat transfer, by P.S. Ghoshdastidar, Oxford University Press

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181606	Accountancy	2-0-0	2

MODULE 1:
Concept and classification of Accounts, Transaction, Double Entry system of Book Keeping, Golden rules of Debit and Credit, Journal- Definition, advantages, Procedure of Journalising, Ledger, advantages, rules regarding Posting, Balancing of Ledger accounts, Trial Balance- Definition, objectives, procedure of preparation

MODULE 2:
Name of Subsidiary Books, Cash Book-definition, advantages, objectives, types of Cash Book, preparation of different types of cash books, Bank Reconciliation Statement, Regions of disagreement between Cash Book with Pass Book balance, preparation of Bank Reconciliation Statement

MODULE 3:
Final Account: Preparation of Trading Account, Profit and Loss Account with adjustments

MODULE 4:
Concept of Capital Expenditure and revenue Expenditure, Baddebts, Provision for Bad and Doubtful debts, Provision for discount on Debtors, Outstanding expenses, Prepaid expenses, Accrued Income

MODULE 5:
Introduction to Depreciation Accounting- Meaning, causes, factors, methods of charging depreciation etc.

Textbooks/Reference Books:

1. Theory and Practice of accountance- KR Das, KM Sinha, KS Pal Choudhury, Dr. A Rahman, PK Pujary
2. Book- Keeping & Accountancy- C Mohan Juneja, J R C Chawla, KK Sakseena
3. Double Entry Book- Keeping & Accountancy- JR Batliboi

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181612	**Fluid Mechanics–II Lab**	**0-0-2**	**1**

Course Outcomes (COs):

1. Students will be able to Categorize different regimes in a pipe flow, visually and theoretically using Reynolds Apparatus
2. Students will be able to Estimate laminar boundary layer thickness over a flat plate at different positions, provided with a wind tunnel setup

LIST OF EXPERIMENTS

Exp-1. Reynolds Apparatus with Storage Tank
Exp-2. Calibration of Wind Tunnel
Exp-3. Boundary Layer Growth Over Flat Plate

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181613	**Mechanical Measurements and Instrumentation Lab**	**0-0-2**	**1**

Course Outcomes (COs):

This course aims to improve students understanding of the concepts, principles, problems, and practices of mechanical measurement systems. After completing this course, students should be able to:

CO1: Understand the methods and devices for mechanical measurements

CO2: Formulate objective(s) and identify key factors in designing experiments for a given problem

CO3: Apply the concepts of calibration, traceability and uncertainty for accurate and reliable measurements

CO4: Identify and estimate measurement errors and suggest suitable techniques to minimize them

CO5: Analyze and discuss the results to draw valid conclusions

LIST OF EXPERIMENTS

Exp-1: Experiment for displacement measurement

Exp-2: Experiment for speed measurement

Exp-3: Experiment for force measurement

Exp-4: Experiment for torque measurement

Exp-5: Experiment for strain measurement

Exp-6: Experiment for temperature measurement

Exp-7: Experiment for pressure measurement

Exp-8: Experiment for flow measurement

Exp-9: Experiment for study of control valves

Exp-10: Experiment for process control study

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181615	**Heat Transfer-II Lab**	**0-0-2**	**1**

Course Outcomes (COs): After successful completion of the course, the student will be able to:
CO1: Estimate convective heat transfer coefficient for forced and free convection and compare the values under steady state condition
CO2: Determine various related parameters in drop and film condensation process
CO3: Demonstrate the heat pipe and deduce its practical applications

LIST OF EXPERIMENTS:

Experiments on Convection

1. Calculation of heat transfer coefficient of forced convection in internal pipe flow
2. Calculation of heat transfer coefficient of natural convection for a vertical tube
3. Determination of heat transfer coefficient in drop and film condensation phenomenon
4. Heat pipe demonstration

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
MECHANICAL ENGINEERING

7th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure
(From Academic Session 2018-19 onwards)

B.Tech 7th Semester: Mechanical Engineering
Semester VII/ B.TECH/ME

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	ME181701	Vibration of Mechanical Systems	3	0	0	3	30	70
2	ME181702	Applied Thermodynamics - II	3	0	0	3	30	70
3	ME181703	Industrial Engineering and Management	3	0	0	3	30	70
4	ME181PE1*	Program Elective -1	3	0	0	3	30	70
5	ME181OE1*	Open Elective -1	3	0	0	3	30	70
6	HS181704	Principles of Management	3	0	0	3	30	70
Practical								
1	ME181722	Project-1	0	0	8	4	50	50
2	ME181723	Grand Viva Voce-I	0	0	0	1	0	50
3	SI181721	Internship-III (SAI - Industry)	0	0	0	2	0	200
		TOTAL	18	0	8	**25**	**230**	**720**
Total Contact Hours per week: 26								
Total Credit: 25								

Program Elective-1

Sl No	Code	Subject
1	ME181PE11	Hydraulic Machines
2	ME181PE12	Machine Tools
3	ME181PE13	Power Plant Technology
4	ME181PE14	Quality Engineering
5	ME181PE15	Refrigeration
6	ME181PE16	Rotordynamics
7	ME181PE1*	Any other subject offered from time to time with the approval of the University

Open Elective-1

Sl No	Code	Subject
1	ME181OE11	Operation Research
2	ME181OE12	Renewable Energy Sources
3	ME181OE13	Solid Waste Management
4	ME181OE1*	Any other subject offered from time to time with the approval of the University

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181701	**Vibration of Mechanical Systems**	**3-0-0**	**3**

Course Outcomes (COs):

CO1: Construct free body diagram and formulate the equation of motion for free vibration of mechanical system under damped and undamped conditions.

CO2: Develop mathematical models of physical systems under forced vibration using Newton's laws of motion and principles of conservation of energy and solve.

CO3: Analyze results of seismic instruments to estimate vibration parameters.

CO4: Evaluate vibration parameters and noise for multi degrees of freedom system and estimate the critical speed of a shaft for whirling motion.

CO5: Develop mathematical model using MATLAB for mechanical vibrating system.

MODULE 1:

Basic Concepts: Introduction, importance, main causes of vibration, characteristics of vibration, harmonic analysis, beats, periodic and non-harmonic excitation, mathematical models, elements of a vibratory system, lumped or discrete parameter system, continuous or distributed parameter systems, equivalent springs and dashpots.

MODULE 2:

Undamped Free Vibration: Introduction, derivation of differential equation of motion-energy method, Newton's 2nd law method, Rayleigh's method, solution of differential equations of motion, angular oscillation, compound pendulum.

MODULE 3:

Damped Free Vibration: Introduction, viscous damping, free vibration with viscous damping – over damped, critically damped and under damped systems, critical damping coefficient, logarithmic decrement, Coulomb damping, structural damping, interface damping: comparisons.

MODULE 4:

Forced Vibration SDOF (Single Degree of Freedom System): Introduction, forced harmonic vibration, magnification factor, resonance, excitation due to rotating and reciprocating unbalance, vibration isolation, force transmissibility, motion transmissibility.

MODULE 5:

Two Degrees of Freedom System (2DOF): Introduction, principal modes of vibration, modes shapes, torsional Vibration, coordinate coupling static and dynamic, dynamic vibration absorber, torsional vibration absorber, pendulum type vibration absorber, generalized co-ordinates.

MODULE 6:

Seismic Instruments: Introduction, vibrometer, accelerometer, phase distortion.

MODULE 7:

Multi Degree of Freedom Systems (MDOF): Introduction, equation of motion, matrix methods, orthogonality and principal modes of vibration, approximate method of determining fundamental frequencies- Dunkerley's method, Rayleigh's method, Holzer's methods, method of matrix iteration.

MODULE 8:

Introduction to Whirling Motion and Critical Speed, critical speed of a single rotor, multiple rotors. Introduction to Noise Engineering.

Textbooks/ Reference Books:

1. Mechanical Vibrations, Singiresu S Rao, Pearson
2. Vibration Theory & Application, W T Thomson, Prentice–Hall
3. Mechanical Vibrations, V P Singh, Dhanpat Rai & Co
4. Mechanical Vibration & Noise Engineering, A G Ambekar, Prentice–Hall

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181702	**Applied Thermodynamics - II**	**3-0-0**	**3**

Course Outcomes (COs): On successful completion of this course the student should be able to:

1. Analyse the thermodynamic processes and cycles involved in compressors, gas turbines, jet engines and refrigerator systems using air/gas as working fluid to reduce them to solvable mathematical models.
2. Estimate all the design parameters of the components used in thermodynamic devices using thermo-fluidic considerations.
3. Estimate the effects of irreversibility on the design of the single-process thermodynamic devices from thermodynamic properties.
4. Compare the performances in terms of efficiency, power and COP of each of the thermodynamic devices for selection in domestic and small industrial applications.
5. Evaluate the positive and negative aspects of space heating and cooling technology with reference to environment using psychrometric properties.

MODULE 1: Air Compressors

Introduction; Reciprocating type – Single stage and multi-stage, Compression ratio and volumetric efficiency, effect of clearance, compressor efficiencies. Methods for improving thermal efficiencies. Compressor work and power. Intercooler and after-cooler. Rotary compressors – Classification, Centrifugal compressors – theory of operations, impeller and diffuser, impeller work; efficiency. Rotary Vs Reciprocating compressor. Introduction to axial flow compressors, charging and choking of compressors.

MODULE 2: Gas Turbine

Introduction – gas turbine cycles – open and closed, Ideal and Actual cycles. Isentropic efficiencies and thermal efficiencies. Power output. Methods to improve thermal efficiencies; Gas turbine vs I C Engines.

MODULE 3: Jet and Rocket Propulsion

Introduction. Types of jet engines – turbojet, turboprop, ramjet, pulsejet. Analysis of turbojet engine cycle, thrust, jet thrust, propeller thrust, effective speed ratio, specific fuel consumption, thrust, impulse, performance. Types of rocket engines – solid propellants rockets, liquid propellants rockets, hybrid rockets, analysis of rocket propulsion, performance, comparison between jet and rocket propulsion.

MODULE 4: Refrigeration

Introduction – Reversed Carnot cycle and air refrigeration cycles; COP; Capacity of a refrigerating unit. Vapour compression and vapour absorption cycles. Properties of refrigerants. Heat pump.

MODULE 5: Psychrometry

Introduction; Psychrometric terms; Delton's law of partial pressures. Psychrometric processes. Psychrometric Chart. Psychrometr.

Textbooks/ Reference Books:

1. Engineering Thermodynamics (Principles and Practices, Dr D S Kumar, Kataria and sons, First Edition, 2012.
2. Applied Thermodynamics, T. D. Eastor and A McConkey, 5th Edn (18th impression), Pearson Education, 2015.
3. Engineering Thermodynamics, P K Nag, 5th Edn, McGraw Hill Publications, 2013.
4. Thermodynamics – An Engineering Approach, Cengel and Boles, 5th Edn, Tata McGraw Hill Publications, 2006.
5. Thermal Engineering, R Rajput, Laxmi Publications, 2014.
6. Engineering Thermodynamics, Rogers and Mayhew, 4th Edn (2nd impression), Pearson Education, 2007.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181703	Industrial Engineering and Management	3-0-0	3

Course Outcomes (COs): After the completion of the Course, the students will be able to:

1. Explain the concept of Organization, functions of Management and Organization types
2. Analyze the problems to related to Plant Location and Layout for optimal solutions
3. Utilize the concept of Project Management to solve various problems related to time optimization of Projects
4. Explain the concepts of Work Study, Product Design, Production Planning and Control and Inventory Management
5. Explain the concepts of Maintenance and Quality Control Techniques practice in Organizations

MODULE 1: Introduction to Organization (2 Lectures)

Definition of organization, organizational structure, types of organization, span of control, delegation of authority and responsibility.

MODULE 2: Plant Location and Layout (4 Lectures)

Objectives, Locational factors, Economics of plant location; Meaning, objectives and types of plant layout and their relevance to mass, batch and job-order production systems.

MODULE 3: Network Analysis (6 Lectures)

Objectives, Network development technique, Network computations – Critical Path and its significance, Earliest and Latest dates, calculation of float. Deterministic and probabilistic network models, Assumptions and computations related to PERT model, Crashing of jobs for minimum cost-time schedule for CPM models

MODULE 4: Work Study (6 Lectures)

Meaning and scope, subdivisions of work study – Method/Motion study and Work Measurement; Method/Motion study- its meaning and scope, steps in method/motion study, Tools and techniques of method/motion study, Principles of motion economy; Micro-motion study – Meaning and scope, therbligs, use of motion camera in micro-motion study; Work measurement – concept of observed time, rating factor, average worker and standard time for jobs. Use of stop watch and work sampling techniques in the determination of standard time.

MODULE 5: Product Design and Development (6 Lectures)

Meaning of product, Product life cycle (PLC) and Product mix; Decisions to be taken during product development and design, Procedure for product development and design, Value of a product – its meaning, Value Analysis

MODULE 6: Production Planning and Inventory Control (6 Lectures)

Meaning and Objectives, Effects of types of production, steps in Production Planning and Control, Use of Gantt chart, Machine Scheduling Problems, Make/Buy decision and Break-even analysis and Inventory Control: EOQ Model, ABC, VED, FSN analysis.

MODULE 7: Maintenance Management (6 Lectures)

Meaning and Types of maintenance, and their suitability, Standards of maintenance, Total Productive Maintenance (TPM).

MODULE 8: Quality and Quality Control Engineering (6 Lectures)

Meaning of Quality, Inspection, Quality Control, Process Control, Control Charts, Acceptance Sampling, Total Quality Management Philosophy

Textbooks/ Reference Books:

1. Industrial Engineering and Management - O P Khanna.
2. Industrial Engineering – M Telsang
3. Essentials of Management – Koontz O' Donnel
4. Industrial engineering – M Mahajan
5. Operations Management – Panneerselvam
6. Motion and Time study – R M Barnes
7. Network and project management – Punmia
8. Total Quality Management – Besterfield et.al.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181PE11	**Hydraulic Machines**	**3-0-0**	**3**

Course Outcomes (COs):

1. Students will be able to extend knowledge of fluid mechanics to understand working of different types of hydraulic machines namely turbines and pumps.
2. Students will be able to recognize different types of turbines based on their working principles and calculate the work output and efficiency to draw the characteristic curves.
3. Students will be able to differentiate the principles of operation of different types of pumps to draw a comparison between them.
4. Students will be able to illustrate the performance characteristics of pumps.
5. Students will be able to deduce problems related to the various types of hydraulic machines, and calculate their working parameters and estimate the optimum working conditions.

MODULE 1:
Eular equation for turbo machines, Radial, axial and mixed flow machines. Impulse and Reaction machines

MODULE 2:
Impulse turbine- Pelton wheel, wheel diameter, jet diameter, bucket shape, size and number, speed control of Pelton wheel. Use of Pelton wheel and efficiency, specific speed and specific diameter range

MODULE 3:
Reaction Hydraulic turbine- Francis turbine – runner, flow and speed ratio, casing guide, vanes, flow control, speed control, runner shape variation with the change of specific speed. Draft tube, surge tank, penstock, cavitation. Axial flow turbine and Kaplan turbine. Blade profile, specific speed, diameter change of blade, pitch, guide vane, flow control, cavitation characteristics, draft tube, speed control of Kaplan turbines.

MODULE 4:
Centrifugal Pump and Reciprocating pump- Centrifugal pumps-single and multistage, radial and mixed flow pumps, vane pump, volute casing pump. Pump efficiencies-hydraulic efficiency, overall efficiency, loss in pump, speed ratio, efficiency. Pump characteristics- surging, cavitaion on pump. Priming of centrifugal pumps, self priming of pumps, multi stage pumps, runner, casing and stationary vanes. Axial pump-specific speed, flow ratio, speed ratio characteristics, applications. Propeller pump, blade-shape and aerofoil analysis-lift and drag estimate of pressure rise and power requirements

MODULE 5: Fluid System- Fluid couplings, Hydraulic dynamometer, Gear pumps

Textbooks/ Reference Books:

1. A Textbook of Fluid Mechanics and Hydraulic Machines by Dr. R.K. Bansal, Laxmi Publications (P) Ltd.
2. Introduction to Fluid Mechanics and Fluid Machines by S.K.Som, Gautam Biswas and Suman Chakraborty, Tata McGraw Hill Publication
3. A Textbook of Fluid Mechanics and Hydraulic Machines by Er. R.K. Rajput, S Chand Publications

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181PE12	**Machine Tools**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the students will be able to:

1. Apply principles of mechanics of machining in determination of force, torque, power etc. in metal cutting
2. Apply the concept of kinematic principles in design of machine tool drive
3. Apply the basic principles in design of hydraulic and also electrical drive
4. Apply the concept of machine tools for semi-automatic or automated production
5. Apply the principles of machine tools in economics of production

MODULE 1:
Metal cutting fundamental principles. Forces acting on the cutting tools. Merchant's theory of metal cutting. Vibration and chatter during metal cutting processes. Tool wear, tool life in relation to speed and surface.

MODULE 2:
Design and constructional principles of machines tools. Basic features of construction and fundamental kinetics requirements of machine tools.
Kinematic drives of machine tools – selection of range of speeds and feeds; layout in G P. – Ray diagrams for machine tools, gear boxes sliding and clutches drives. Feed gear-box analysis.

MODULE 3:
Considerations affecting the design of machine tools (Lathe, Milling and drilling machines) with reference to their purpose, strength, rigidity and accuracy. Single purpose and general purpose machine tools – effect on design.

MODULE 4: Application of hydraulic drives – circuit diagram, pumps and valves. Effect on power consumption and surface finish.

MODULE 5: Electric equipment for machine tools. Characteristics demanded from the machine tools.

MODULE 6: Automation in machine tools – Capstan and Turret lathe and their operation lay out. Single spindle automatic screw cutting machine tools and their cam lay out. Swiss type automatics.

MODULE 7: Economics of automation, Elementary principle of numerical control of machine tools, Acceptance tests for machine tools.

Textbooks/ Reference Books:

1. Principles of machine tools, Vol I & II, by G C Sen and A Bhattacharyya.
2. Design of machine tools by S K Basu
3. Design of machine tools by S K Basu and D K Pal
4. Production Technology, Vol II, by Dr. O P Khanna

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181PE13	**Power Plant Technology**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the student will be able:

CO1: Identify the different components of power plants and understand local and global energy scenario.
CO2: Evaluate the performance of steam power plant and its different components.
CO3: Compare the working and performance of diesel and gas turbine power plant.
CO4: Differentiate the working and relative merits between different non-conventional power plants.
CO5: Analyse the economics of power generation in different power plant.

MODULE 1:
Introduction of local and global Energy Scenario, history of power plant technology, key terminologies, various components and basic concepts of power plant, Resources and development. Concepts of captive power plant and co-generation Types of power plants

MODULE 2:
Steam turbine, Site selection, General lay-out of thermal power plants, Energy losses in steam turbine, Steam Generator- High Pressure Boiler, Economiser, Superheater, Reheater, Regenerator, Air preheater, coal firing furnace, fluidised bed combustion, waste heat boiler

MODULE 3:
Diesel Electric power plant, Plant layout, Engine performance, Gas Turbine Power Plant, Site selection, layout, fuels, materials, combined cycle

MODULE 4: Hydro Electric Power Plant, Classification, Hydro turbine, Principles of Nuclear Energy, Nuclear power plant, Fast breeding reactors

MODULE 5: Non-Conventional Power Plants- Geothermal, Wind, Solar power plants and Direct Energy Conversion Systems, Economics of power generation

Textbooks/ Reference Books:

1. Power Plant Technology Author: M.M. El-Wakil Publisher: McGraw-Hill Education
2. Power Plant Engineering Author: Domkundwar, Arora, Domkundwar Publisher: Dhanpat Rai & Co
3. Thermal Engineering Author: R.K.Rajput Publisher : Laxmi Publication
4. Steam Turbine Theory and Practice Author: William J. Kearton Publisher: CBS Publication
5. Gas Turbines Author: V Ganeshan, Publisher: McGraw Hill Education

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181PE14	**Quality Engineering**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the student will be able:

1. Recall and explain the basic concepts of Quality, Evolution of Quality, Variations, Quality Characteristics, classification of Quality Characteristics, Internal and External Customers, Juran's Quality Trilogy, Cost of Quality
2. Explain Statistical Process Control, Statistical Aspects of Quality Control, Type I and Type II Error in Statistical Analysis, Shewart Control Charts for Variables and Attributes. Interpretation of the Charts
3. Develop Sampling plans: Single, double, multiple and Sequential Sampling Plans
4. Explain Sampling Schemes and Sampling Systems, application of Dodge and Romig Tables
5. Explain and apply the Concepts of TQM, the salient contributions of Quality Gurus like Deming, Juran and Crosby, Deming's Philosophy leading to TQM, philosophy of Continuous Improvement, Quantification of Quality, Quality Scales, Six Sigma Approach, Reliability

MODULE 1: Introduction (8 Lectures)

The history and Background of Quality Control, Need for Quality Control, Evolution of Quality Control and different Quality Management Philosophies(Overview), Quality Assurance - Phases of Quality Assurance. Quality Definition: Characteristics / dimensions of quality, Juran's Quality Trilogy Quality Spiral, Causes of Variation change and Assignable Causes. Quality Costs: Reason for Quality Costs Analysis, Categories of Quality Costs(Cost of poor Quality), Concept of Optimum Quality Cost Model

MODULE 2: Statistical Concepts (7 Lectures)

Sample Parameters and Universe Parameters, Central Tendency and Dispersion and their measures, Data Representation Frequency Distribution Curves, Continuous and Discrete Distributions, Normal curve and its characteristics, Normal Table, Hypothesis Testing, Chi-square distribution. Inspection: Types of Inspection, Inspection Error, Inspection and Quality, Samples Inspections- Its Importance and Application Theory of Sampling: Population and Sample, Sample Statistics and Population Parameters, Rational Sub Grouping, Stewart Normal Bowl Experiment.

MODULE 3: Statistical Process Control (10 Lectures)

Statistical Aspects of Quality Control, Type I and Type II Error in Statistical Analysis, Shewart Control Charts-Variable and Attribute Charts (X,R-charts, b-chart, c-chart, up-chart) Control Charts for Variables: X Bar and R Charts, X Bar and Sigma Charts construction of the charts. Interpretation of the Charts. Manufacturing and Non-Manufacturing Application of the Charts. Control Charts for Attributes: p Chart, 100p Chart, n-p Chart, c Chart, U chart Interpretation of the Charts, Application

MODULE 4: Acceptance Sampling Plans for Attributes (10 Lectures)

Introduction, Importance, Situation leading to Economic Use Sampling Plans, Concept of AQL and relevant terms, OC Curves-Type A and Type B OC Curves, Different types of Sampling Plans, ASN Curve, ATI Curve. Sampling Schemes-MIL STD105D-Rules for Switching, Dodge and Romig Tables: Acceptance Sampling Plans for Variables: Introduction, Sampling Plans for Sigma Known and Sigma Unknown, Application.

MODULE 5: Concept of Total Quality Management (7 Lectures)

Introduction, Tools and Techniques of TQM, Brief Introduction Reliability: Distinction between Reliability and Quality, Relevant Terms, The Characteristics Curve (Bath-Tub Curve), Failure- Types, Causes of Failure, Reliability Function in terms of Failure Rate and its characteristics, Reliability improvement- Series and parallel Systems

Textbooks/ Reference Books:

1. Principles of Quality Control: Jerry Banks: Publisher: John Wiley & Sons
2. Introduction to Statistical Quality Control: Douglas Montgomery: Publisher: John Wiley & Sons
3. Statistical Quality Control: Eugene Grant and Richard Leavenworth: Publisher: Mc Graw Hill
4. Total Quality Management : Dale H., Besterfield, Glen H. Besterfield, Mary Besterfield-sacre: Publisher: Pearson

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181PE15	**Refrigeration**	**3-0-0**	**3**

Course Outcomes (Cos): At the completion of the course the student will be able:

1. Students will be able to *describe* refrigeration process and *illustrate* different related thermodynamic cycles.
2. Students will be able to *list* different applications of refrigeration and *analyse* the respective processes.
3. Students will be able to *categorise* and *compare* different types refrigerants used for various applications.
4. Students will be able to *explain* various refrigeration equipment used in VCRS and VARS.
5. Students will be able to *explain* and *analyse* practical refrigeration systems namely Vapour compression (VCRS) and Vapour absorption refrigeration cycles (VARS) and other non-conventional refrigeration systems.

MODULE 1: Refrigeration

Introduction, history, methods of refrigeration, Ice, Evaporation expansion of air, throttling of gas, vapour compression and absorption, steam jet, liquid gas, dry ice, units of refr. Difference between engine, refrigerator and heat pump.

MODULE 2: Gas Cycle Refrigeration

Simple cycles – Carnot and Bell-Coleman; Regenerative & reduced ambient system; Air-craft refrigerating system - simple boot-strap, reduced ambient; Actual cycles, ramming; Advantages and disadvantages of DART.

MODULE 3: Vapour Compression Systems

Analysis of simple cycles, representation of TS, pH plans; methods of improving COP; Deviations of actual cycles from theoretical cycles. Compound compression with liquid flash cooler, flash inter-cooler multiple systems – COP, power required, Ewing diagram.

MODULE 4: Vapor Absorber Ref. System

Thermodynamical analysis of systems, Advantages and disadvantages, Components, Practical systems NHe Watt. Water LiBr, Electrolux systems, Calculations based on concentration; Properties of binary mixtures.

MODULE 5: Non – Conventional Ref. System

Steam jet ref. Thermoelectric, Vortex tube refr. – merits and demerits and applications.

MODULE 6: Refrigerants

Nomenclature, classification, desirable properties. Important refrigerants and their comparisons, selection of refrigerants.

MODULE 7: Ref. Equipment

Brief introduction to compressors, condensers, expansion devices, evaporators; Piping, line valves, solenoid valves, oil separators, driers, filters, moisture indicators, purging and controls.

MODULE 8: Application of Refrigeration

Production of dry ice, cascading, multi-staging domestic, commercial, industrial and medical, preservator of food-spoilage, methods of preservation, cold storage, preparing of insulating materials using in ref. Systems.

Textbooks/ Reference Books:

1. Refrigeration and Air-Conditioning by Ahmedul Ameen, PHI
2. Refrigeration and Air-Conditioning by C.P.Arora, Tata McGraw Hill Publication.
3. Refrigeration and Air-Conditioning by M.Prasad

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181PE16	**Rotordynamics**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the student will be able:

1. Predict rotor system dynamic characteristics for design of any type of machinery.
2. Develop knowledge of problems relating to rotating machineries during operation such as unbalances, misalignment, gyroscopic effect
3. analyze torsional vibration of rotor for high power transmission and high speed application
4. Identify rotor bearing system parameters and apply in futuristic model based condition monitoring
5. Develop knowledge about recent development in active magnetic bearing.

MODULE 1: Simple Rotor System (6 Lectures)
Basic transverse vibration of Single DOF rotor model, Jeffcott Rotor with central and offset disc, calculation of natural frequencies

MODULE 2: Transverse Vibration of Simple Rotor Bearing Foundation System (4 Lectures)
Symmetrical rigid and flexible shaft on Anisotropic bearing, unbalance forces, bearing forces

MODULE 3: Gyroscopic Effect in Rotor System (6 Lectures)
Effect of spinning disk, synchronous whirl of an overhang rotor, asynchronous rotational motion

MODULE 4: Tranverse Vibration of Multi Dof Rotors (3 Lectures)
Influence co-efficient method for static and dynamic case

MODULE 5: Torsional Vibration of Rotors (8 Lectures)
Direct and transverse matrix method, TMM for geared and branched system.

MODULE 6: Balancing of Rotors (4 Lectures)
Rigid rotors balancing single and two plane balancing, flexible rotor balancing

MODULE 7: Active Magnetic Bearings in Rotors (6 Lectures)
Basics of active magnetic bearing, block diagram and transfer functions, tuning of the controller parameters

MODULE 8: Signal Processing in Rotating Machineries and Condition Monitoring (3 Lectures)

Textbooks/ Reference Books:

1. J. S. Rao, Rotor Dynamics, Third Ed., New Age, New Delhi.
2. M. J. Goodwin, Dynamics of Rotor Bearing System, Unwin Hyman, Sydney.
3. Rajiv Tewari, Rotor Systems, Analysis and Identification, CRC Press.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181OE11	**Operation Research**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the student will be able:

1. To analyze techno-managerial problems for effective use of resources in professional life.
2. To analyze & solve engineering and managerial problems by classical methods and interpret results.
3. To identify technical and managerial situations needing effective, economic and efficient methods for problem solution.
4. To formulate mathematical models for optimization of engineering & business problems for quantitative analysis, solution and interpretation of results.
5. To formulate and solve problems by simulation technique in engineering problems to verify and validate the model

MODULE 1:

Introduction to OR, Engineering applications, Statements of an OR problems, Types of problems handled in OR

MODULE 2:

a) Linear programming (deterministic)- Problem formulation, Feasibility and optimality, Basic and Non-basic solutions.
b) Graphical methods of solving LPP, Simplex Algorithm and problem solution, use of slack, surplus and Artificial variables and their meanings.
c) Big-M method and 2-phase method.
d) Dual Simplex algorithm.
e) Meaning and examples of unique, Alternate/Multiple, unbounded and Infeasible solutions.
f) Degeneracy and cycling

MODULE 3:

Special Linear Programming Problems – their formulations and solutions in such cases as Integer Programming Problems (IPP), Transportation problem (TP) and Assignment Problem (AP). Discussion on method extended to Travelling Salesman Problem (TSP)

MODULE 4:

Classical Optimization – Introduction, single and Multi-variate problems, Lagrangean method, Karush-Kuhn Tuker (KKT) conditions.

MODULE 5:

Inventory modelling – Classification of inventory, Deterministic versus Stochastic problems situations, Formulation and solution of Deterministic inventory problems.

MODULE 6:

Simulation – Meaning, Monte-Carlo simulation, generation of random observations, use of digital computers in simulation, Discussion on Simulation examples such as inventory, queuing etc.

Textbooks/ Reference Books:

1. Operations Research –H A Taha
2. Operations Research –Gupta and Hira
3. Operations Research –Billy E Gillet
4. Operations Research –Panneerselvam
5. Optimization – S S Rao
6. Operations Research – N G Nair
7. System Simulation by digital computers – N Deo

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181OE12	Renewable Energy Sources	3-0-0	3

Course Outcomes (COs): At the completion of the course the student will be able:

1. Identify energy demand and relate with available energy resources and also explain the Non-conventional energy sources & systems
2. Analyze harnessing of solar energy
3. Analyze harnessing of wind energy
4. Analyze harnessing of Biomass energy
5. Analyze harnessing of Geothermal and Ocean energies
6. Analyze Magneto hydrodynamics and Fuel cell technology

MODULE 1:
Different forms of non-conventional energy sources: Solar, Bio-gas, wind, tidal, geothermal etc.

MODULE 2: Basic Bio-Conversion Mechanism
Source of waste, simple digesters; composition and calorific value of biogas, Bio-mass as a source of energy, energy plantation, production of fuel from wood, agricultural and municipal solid and animal wastes, sludge and waste water, bio-gas generation and utilization

MODULE 3: Solar Option
Energy from sun – availability of solar radiation, technique of collection, storage and utilization; Types of solar collectors; selective surfaces; solar thermal processes – heating, cooling, drying, power generation etc. Thermoelectric conversion and thermal storage. Introduction to photoelectric conversion

MODULE 4: Wind and Tidal Energy Generation
Special characteristics, turbine parameters, optimum operation, electric power generation from wind/tidal energy; Types of wind mills, Elementary design principles, Principle of ocean thermal energy conversion; Power plant based on OTEC

MODULE 5: Geothermal Energy
System. Extent of available resources. Heat transport in geothermal systems. Hot springs and steam injections

MODULE 6: The Nuclear Options
Fission, fusion technology fundamentals. Thermal and fast reactors. State of art Breeder reactors, prospect and limitations, economics. Fusion energy – controlled fusion of H_2, He etc. Energy release rate, future possibilities

MODULE 7: Direct Conversion Methods
Thermo-ions, MHD, electrochemical devices, fuel cells etc. Intrigated energy packages using solar, biomass, wind etc.

MODULE 8: Comparative study of non-conventional energy source, cost consideration and economic

Textbooks/Reference Books:

1. Waste water Engineering - by MetCaff, Eddy – McGrow Hills
2. Solar Energy - by SP Sukhatme – TMG
3. Solar Energy Utilization - Duffie & Beckman – Wiley Int. Ltd.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181OE13	**Solid Waste Management**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the student will be able:
CO1: Explain the principles of Solid Waste Management
CO2: Apply modern techniques at different stages of waste processing
CO3: Design solid waste management system for any area
CO4: Understand the environmental problems relating to solid waste management
CO5: Cater to the needs of the society for implementing scientific waste management

MODULE 1: Introduction to Solid Waste Management
Introduction to Solid Waste, 4-R Principle in waste minimization, Concept of Zero Waste, Types and Sources of Solid Waste, Characteristics & Quantification technique of Solid Waste, Legislation & Regulations

MODULE 2: Collection Systems of Solid Waste
Refuse collection: Primary collection system, secondary collection system, transfer to disposal site, Commercial wastes, Transfer stations

MODULE 3: Processing of Municipal Solid Waste
Storing, Conveying, Compacting, Shredding, Material separation, Trommel screens, magnets & electromechanical separators

MODULE 4: Biochemical Processes
Fundamentals of Composting, Different techniques of Composting, anaerobic digestion, Bio-gas production

MODULE 5: Combustion and Energy Recovery
Incineration, Waste to energy combustors, Pyrolysis, Plasma Gasification, Undesirable effects of combustion

MODULE 6: Current Issues in Solid Waste Management
Life cycle analysis & management, social stigma associated with waste management, public or private ownership, financing solid waste facilities, role of solid waste engineer

Textbooks/ Reference Books:
1. P. Aarne Vesilind, William Worrell, Reinhart, Solid Waste Engineering, Thomson Publishing House
2. Prasad Modak, Waste Minimization- A Practical Guide to Cleaner Production & Enhanced Profitability, Centre for Environment Education, Ahmedabad

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181704	Principles of Management	3-0-0	3

MODULE 1: Introduction (6 Lecture)
Definition and meaning of management, Characteristics of management, importance of management, functions of management-planning, organising, directing, staffing, coordination and controlling etc., principles of management, Difference between administration and management

MODULE 2: Financial Management (6 Lecture)
Definition and management of financial planning, importance and characteristics of sound financial plan, concepts of capital- fixed capital and working capital, source of finance, fund flow statement

MODULE 3: Marginal costing (6 Lecture)
Definition and meaning of marginal costing, advantages, marginal cost equation, contribution, profit-volume ratio, break even analysis, margin of safety

MODULE 4: Cost Accounting (6 Lecture)
Cost Accounting- Concept and benefit, elements of cost, preparation of cost sheet with adjustment of raw materials, work-in-progress and finished goods

MODULE 5: Capitalisation (4 Lecture)
Definition and meaning of capitalisation, over and under capitalisation

MODULE 6: Motivation (6 Lecture)
Introductory observation, definition of motivation, motivational technique, features of sound motivational system

MODULE 7: Leadership (6 Lecture)
Concept of leadership, principles of leadership, functions of leadership, qualities of leadership, different styles of leadership

Textbooks/Reference Books:

1. Principle of Business Management: RK Sharma, Shashi K.Gupta
2. Business Organisation and Management: SS Sarkar, RK Sharma, Shashi K.Gupta
3. Industrial Organisation and Management: SK Basu, KC Sahu, B Rajviv
4. Principles of Management by Dr. A. K. Bora: Chandra Prakash, Guwahati.
5. Management Accounting: RK Sharma, Shashi K Gupta
6. Cost Accounting: SP Jain, K I Narang
7. Cost Accounting, RSN Pillai, V Bhagawati
8. Principles of Management: RN Gupta
9. Principles of Management: RSN Pillai, S. Kala
10. Principles of Management: Dipak Kumar Bhattacharjee

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181722	Project-1	0-0-8	4
GUIDELINES WILL BE ISSUED BY THE UNIVERSITY FROM TIME TO TIME			

Course Code	Course Title	Hours per week L-T-P	Credit C
SI181721	Internship-III (SAI - Industry)	0-0-0	2
GUIDELINES WILL BE ISSUED BY THE UNIVERSITY FROM TIME TO TIME			

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ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
GUWAHATI

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
MECHANICAL ENGINEERING
8th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure

(From Academic Session 2018-19 onwards)

B. Tech 8th Semester: Mechanical Engineering

Semester VIII/ B. TECH/ME

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	ME181801	Manufacturing Methods	3	0	0	3	30	70
2	ME1818PE2*	Program Elective - 2	3	0	0	3	30	70
3	ME1818PE3*	Program Elective - 3	3	0	0	3	30	70
4	ME1818OE2*	Open Elective - 2	3	0	0	3	30	70
Practical								
1	ME181822	Project -2	0	0	12	6	100	50
2	ME181823	Grand Viva Voce-II	0	0	0	1	-	50
TOTAL			**12**	**0**	**12**	**19**	**220**	**380**
Total Contact Hours per week : 24								
Total Credits: 19								

Program Elective-2 Subjects		
Sl. No.	**Subject Code**	**Subject**
1	ME1818PE21	Air Conditioning
2	ME1818PE22	Mechatronics
3	ME1818PE23	Robotics and Applications
4	ME1818PE24	Compressors and Gas Turbines
5	ME1818PE25	Computational Fluid Dynamics
6	ME1818PE2*	Any other subject offered from time to time with the approval of the University

Program Elective-3 Subjects		
Sl. No.	**Subject Code**	**Subject**
1	ME1818PE31	Computer Integrated Manufacturing
2	ME1818PE32	Operations Management
3	ME1818PE33	Internal Combustion Engines
4	ME1818PE34	Composite Materials
5	ME1818PE35	Tribology
6	ME1818PE3*	Any other subject offered from time to time with the approval of the University

Open Elective-2 Subjects		
Sl. No.	**Subject Code**	**Subject**
1	ME1818OE21	Noise and Vibration Control
2	ME1818OE22	Industrial Safety Engineering
3	ME1818OE23	Engineering Economic Analysis
4	ME1818OE24	Automotive Mechanics
5	ME1818OE25	Machining and machine tools
6	ME1818OE2*	Any other subject offered from time to time with the approval of the University

Course Code	Course Title	Hours per week L-T-P	Credit C
ME181801	**Manufacturing Methods**	**3-0-0**	**3**

Course Outcomes (COs): At the completion of the course the student will be able to:

1. Determine mould filling time, total solidification time and design riser for vertical and bottom gating sand moulds.
2. Determine the maximum draft possible in a single pass rolling, number of stages (passes) required and rolling torque and power for given roll diameter, reduction required and coefficient of friction in cold working operation.
3. Determine the forging force required in a forging operation for a given material (defined by a flow curve) and reduction.
4. Determine the ram pressure (force) using Johnson equation in an extrusion process for a given reduction and given material (defined by a flow curve).
5. Determine the drawing force in a wire drawing operation for a given reduction and material (defined by a flow curve).
6. Design blanking and piercing die and punch for a given sheet metal.
7. Determine blank size, number of draws, die and punch size for a given sheet metal in a drawing operation.

MODULE 1: Melting of metals, gases in metals

Different furnaces used in melting. Gating system, Design for sand Casting –Vertical and bottom gating moulds, total solidification time, riser design, aspiration effect.

Solidification behaviour of pure metals and alloy metals, Centerline shrinkage. Special casting methods – Permanent mould casting – Pressure Die casting – Hot chamber, Cold chamber and Air blown methods – Low-pressure die casting, Continuous casting. Non-metallic mould casting – Centrifugal casting, Investment casting.

Casting defects, their causes and remedies, Fettling of casting and Inspection.

MODULE 2: Behaviour of metal in metal in forming

Flow curve and average flow stress, Hot, Cold and Warm working – Variables affecting mechanical working process.

Rolling – Principle – Condition for continuous rolling and maximum draft possible, Forces and power in rolling – Methods for reduction of roll separating force – Rolling mills – Roll pass design – Thread rolling, ring rolling, gear rolling and Roll Piercing – rolling defects.

Forging – Forge ability – Metallurgy of Forging – Open die forging operations, analysis of open die forging, forging force, forging hammers and presses, closed die forging – Drop forging, Press forging, machine forging – Forging die design factors – Forging Defects.

Extrusion – Classification – Analysis of extrusion process, determination ram pressure – Variation of ram pressure with ram travel – Principle of operations of Hydrostatic extrusion, side extrusion, impact and Hooker's extrusion – Defects in extrusion.

Wire, Rod and Tube drawing – Principle and Operation – drawing equipment, drawing die – preliminary operations – tube drawing methods – Analysis of drawing, drawing force, maximum reduction per pass.

MODULE 3: High Energy Rate Forming

Reasons that prompted transition to HERF – Classification – Principles and operations of Explosive Forming, Electro-hydraulic Forming, and Electromagnetic Forming – High Velocity Forming, Principles and Operations of Petro-forging, Dynapak.

MODULE 4: Press working and sheet metal operations

Classification, forming limit diagram – Different types of Press and Selection of Presses – Pattern layout and allowances – Various cutting and forming operations – Principles and Operations of Cutting/Shearing, design for blanking and piercing operations – Methods of reduction of cutting forces. Deep drawing operations – Design for deep drawing – Methods for redrawing – Defects in sheet metal formed parts.

MODULE 5: Surface Finishing Operations

Classification – Principle and Operations of Lapping, Honing, Super finishing, Polishing, Buffing, Tumbling and Burnishing.

MODULE 6: Manufacture of threads and gears

Threads manufacturing – Different methods – Casting, Thread Chasing, Thread Rolling, Die and Tapping, Milling and grinding.

Gear manufacturing - Different Methods – Casting, Forming and Metal removal. Gear Cutting and Gear Generation Processes. Gear Finishing Operations.

MODULE 7: Powder Metallurgy

Advantages and applications of P/M – Powder Characteristics – Powder production methods – Mixing and Blending, Briquetting techniques – Sintering and presintering – Secondary Processes, Infiltration and Impregnation – Production of Cemented carbides.

Textbooks/ Reference Books:

1. Elements of Workshop Technology (Vol. I & II) – S.K. Hajra Choudhury and A.K. Hajra Choudhury.
2. Manufacturing Science–Amitabha Ghosh and Ashok Kumar Mallick, East West Press
3. Production Engineering – P.C. Sharma, S. Chand & Company Ltd.
4. Metal Forming Technology – Dr. R. Narayanasamy, Ahuja Book Co. Pvt. Ltd
5. Mechanical Metallurgy – G.E. Dieter, McGraw Hill

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE21	**Air Conditioning**	**3-0-0**	**3**

Course Outcomes(COs):

1. Given any three psychrometric properties of air students will be able to calculate all other psychrometric properties using equations and/or psychrometric chart.
2. Students will able to define human thermal comfort, its indices and comfort charts and also able to demonstrate the relationship between thermal comfort and human health based on thermodynamics of human body.
3. Students will be able to illustrate different psychrometric processes on the psychrometric charts. Students will be able to calculate the psychrometric properties of air after undergoing a psychrometric process or a combination of more than one psychrometric process.
4. Students will be able to design an air conditioning system for a room for given indoor and outdoor design conditions.
5. Students will be able to design a duct system using any one of the different duct design methods namely equal friction method, velocity reduction and static regain method.

MODULE 1: Psychrometry

Psychrometric properties, representations of properties in charts, preparation of charts

MODULE 2: Psychrometric processes

Constant sensible heat and latent heat processes, adiabatic saturation and enthalpy deviation. Adiabatic mixing of air stream. Humidification, Dehumidification water spray processes, sensible heat factors, grand sensible heat ratio lines, apparatus dew points, Bypass factors, Air washer-humidifying efficiency

MODULE 3: Comfort A/C

Air temperature, human health, body temperature regulation, comfort indices, comfort charts and their limitations

MODULE 4: Load analysis

Inside and outside design conditions, load classification, summer cooling loads, solar heat gain and transmission and radiation. Flywheel effect of building materials, equipment temperature differential loads due to human beings, load due to electric light, equipment and appliances. Infiltrator and ventilator loads, product loads, miscellaneous loads such as duct heat gain, duct air leakage, fans, pumps etc. Winter heat load – computation of loads

MODULE 5: Duct design and Air distribution

Different methods of duct design such as velocity reduction, equal friction and static regain, aspect ratio duct losses, distribution of air in rooms, nature and supply grill; duct arrangement and air handling system

MODULE 6: A/C System

Unitary control system, special features of residential, commercial and industrial A/C system, Year round a/c zoning

MODULE 7: Equipment

(1) Fans – types of fans, characteristics, curves, fan selection. (2) Air filter and cleaner. (3) Cooling towers, evaporators, condensers (4) Cooling coils and water capacity, (5) Chemical dehumidifiers, (6) Heaters, radiators, Convection coils

MODULE 8: Instruments and controls

Temperature, humidity, air velocity measuring instruments, Thermostat, humidistat. By pass and damper control. Dew point control, noise control, Pneumatic control

Textbooks/ Reference Books

1. Refrigeration and Air-Conditioning by Ahmedul Ameen, PHI
2. Refrigeration and Air-Conditioning by C.P.Arora, Tata McGraw Hill Publication.
3. Refrigeration and Air-Conditioning by M.Prasad

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE22	**Mechatronics**	**3-0-0**	**3**

Course Outcomes(COs):
After successful completion of this course, student will be able to:

1. Critically evaluate components of integrated systems
2. Design complete systems by justifying the use of sensors, actuators, control circuits
3. Code logics into PLC and develop closed loop control processes.
4. Utilize Computer Numerical Control to automate manufacturing processes.
5. Learn about Robot hardware and functioning

MODULE 1: Basic concepts
Definition of Mechatronics, Mechatronics in manufacturing, products and design.

MODULE 2: Review of fundamentals of electronics
Data conversion devices, sensors, transducers, signal processing devices, relays, microprocessors, and PLCs.

MODULE 3: Drives
Stepper motors, servo drives, ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems.

MODULE 4: Hydraulic systems
Flow, pressure and direction control valves, actuators, hydraulic pumps, design of hydraulic circuits.

MODULE 5: Pneumatics
Production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.

MODULE 6: Controllers
Description of proportional, integral and derivative (PID) controllers.

MODULE 7: CNC machines and part programming

MODULE 8: Industrial Robotics

Textbooks/ Reference Books:

1. Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering, W. Bolton, Pearson Education Ltd, 2006.
2. Mechatronics-Principles and Applications, Godfrey and Onwubolu, Butterworth-Heinemann, 2006.
3. Computer Automation in Manufacturing - an Introduction, T. O. Boucher, Chapman and Hall, 1996

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE23	**Robotics and Applications**	**3-0-0**	**3**

Course Outcomes (COs):

After completion of the course the student will be able to:

1. Relate basic concepts of robotics for robot classification, anatomy, coordinate systems, degrees of freedom, work envelope, and robot specification to understand its operation.
2. Apply the knowledge of drive systems, actuators, sensors, and control methods to understand the design and working of robots.
3. Model forward and inverse kinematics of robot manipulators and analyze forces in links and joints of a robot.
4. Develop the knowledge of robot vision for image processing, analysis and object recognition.
5. Develop robot programming to perform tasks in industrial applications and extend the knowledge of artificial intelligence (AI) in robotics.

MODULE 1: Overview of Robotics

Definition and classification of robot manipulators, coordinate frames, robot configuration, motion and degrees of freedom, work envelope, uses, field of applications, robot specifications.

MODULE 2: Structure and Control of Robotic System

Robot anatomy, mechanical design of robot end-effectors (grippers), gripper mechanism and fingers, robot drive systems, electric drives and servo control in robotics, hydraulic and pneumatic actuators.

MODULE 3: Robot Arm Kinematics

Introduction to direct and inverse kinematics, geometric representation of rotation matrices, Euler angle representation, links and joints parameters, homogeneous transformation and D-H representation, arm matrix and kinematic equation for robot manipulator.

MODULE 4: Robot Arm Dynamics

Jacobian and force vectors, joint velocities, kinetic energy and potential energy of a robot manipulator, Lagrange-Euler formulation for motion, dynamic equation of a robot manipulator, planning of manipulator trajectory.

MODULE 5: Introduction to Sensors and Robot Vision

Classification of sensors and their functions, overview of computer vision and robotic applications of vision, elements of a vision system, lighting techniques and devices, image processing and analysis, object recognition.

MODULE 6: Robot Programming

Introduction to robot programming, application of robot programming for simple functions, introduction to artificial intelligence in robotics, mobile robotics and distributed robotics.

Textbooks/ Reference Books:

1. Robotics: Control, Sensing, Vision and Intelligence – K.S. Fu, R.C. Gonzalez and C.S.G. Lee, McGraw-Hill.
2. Introduction to Robotics – J. J. Craig, Addision-Wesley.
3. A Textbook on Industrial Robotics – Ganesh S. Hegde, University Science Pres

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE24	Compressors and Gas Turbines	3-0-0	3

Course Outcomes(COs):

1. Explain different parts of compressors, gas turbines and jet engines
2. Explain basic details of Turboprop, Turbofan, Turbojet and Ramjet systems.
3. Analyze turbomachines by applying Euler's equation.
4. Perform thermodynamic analysis for turbines and compressors.
5. Choose appropriate blading material for particular applications of turbine and compressor.

MODULE 1: Introduction

Classification of Turbo machines, Application of Euler equation to radial and axial flow turbomachines.

MODULE 2: Centrifugal Compressors

Impeller, blade shape, diffuser, velocity diagram, inlet guide vane and pre-whirl, slip, work done, pressure rise, temperature rise, enthalpy-entropy diagram, efficiency, characteristics, surging.

Axial-flow Compressors: Stage, stage blading arrangement, velocity diagram, blade angles, thermodynamics of the compressor stage, enthalpy-entropy diagram, efficiency, degree of reaction, stage pressure and temperature rise, work done factor, stage loading, pressure ratio of a multistage compressor, surging and stall, characteristics curve.

MODULE 3: Axial-flow Turbines

Impulse Turbines: Single stage and multi stage turbine, blading, velocity diagram, blading efficiency, Thermodynamics of stage, stage enthalpy-entropy diagram, efficiency.

Reaction Turbine: Stage, blading, stage velocity diagram, Thermodynamics of the stage, enthalpy-entropy diagram, efficiency, degree of reaction, free vortex design, variation of degree of reaction with radius, flow characteristics of multistage turbine.

Gas Turbine: Combined cycles, compounding and governing of gas turbine.

MODULE 4: Combustion system

Types of combustion chambers, the combustion chamber performance.

Blading material: Influence of blading material on the maximum temperature of the cycle, desirable properties of a gas turbine blading material, various blading material and their strength and weakness

MODULE 5: Jet Propulsion

Turboprop, turbofan, turbojet and ramjet systems, matching of turbine and compressor.

Textbooks/ Reference Books:

1. Gas Turbine Theory – H.Cohen, G.F.C. Rogers and H.T.H. Saravanemuttoo (Longman Scientific and Technical)
2. Turbines, Compressors and Fans- S.M.Yahava (Tata McGraw-Hill)
3. Gas Turbines and Propulsive system- P.P. Khajuria and S.P. Dubey (Dhanpat Rai and Sons)

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE25	**Computational Fluid Dynamics**	**3-0-0**	**3**

MODULE 1: The Basic Equations of Fluid Dynamics
General form of a Conservation law: equation of mass conservation, conservation law of momentum, conservation equation of Energy.

MODULE 2: The dynamic levels of approximation
The Navier-Stokes(NS) equation: The Reynold's averaged NS equation, The thin layer NS approximation, The parabolized NS approximation, The boundary layer approximation The distributed loss model, The inviscid flow model, Euler equations, steady inviscid rotational flow, The potential flow model, small disturbance approximation of the potential equation, Linearised potential flow, singularity methods, mathematical nature of flow equations.

MODULE 3: Basic discretization techniques
(a)The finite difference method, (b)The finite volume method and conservative discretization.

MODULE 4: Analysis and application of Numerical schemes
Consistency, stability, convergence, Fourier and Von Neumann stability analysis, modified equation, application of finite difference methods, to wave, heat. Laplace and Burger's equation.

MODULE 5: Solution methods
Solution of 1D heat conduction equation, wave equation, Laplace equation using various schemes.

MODULE 6: Heat Transfer
Basics of finite difference and finite element methods: Numerical methods for conduction heat transfer, Numerical methods for convection heat transfer, Numerical methods for radiative heat transfer.

Textbooks/ Reference Books:

1. Computational Fluid Mechanics and Heat Transfer—Hemisphere-Anderson, Tannehill, Pletcher.
2. Computational Heat Transfer-Hemisphere and Springer-Verlag-Jaluria and Torrance
3. Computational techniques for Fluid Dynamics-Verlag-Fletcher and Springer

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE31	**Computer Integrated Manufacturing**	**3-0-0**	**3**

Course Outcomes (COs):

At the completion of the course the student will be able to:

1. Apply the concept of CIM in automated manufacturing systems.
2. Apply the concept of computer aided design in manufacturing and assembly.
3. Apply the knowledge of production and process planning in manufacturing systems.
4. Design flexible manufacturing cell by applying concept of Group Technology and FMS.
5. Apply data management for decision making in CIMS.

MODULE 1: Introduction

Introduction to Automation: Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Advantages & disadvantages of automation, Concept of CIM, information flow in CIM, elements of CIM, benefits and limitations.

MODULE 2: CAD/CAM

Product Design and CAD, application of computers in design, scope of CAD / CAM and CIM, concurrent engineering, design for manufacturing and assembly.

MODULE3: Production Planning and Control

Process planning – Computer Aided Process Planning (CAPP), Logical steps in Computer Aided Process Planning, Aggregate Production Planning and the Master Production Schedule, Material Requirement planning, Capacity Planning, Control Systems, Shop Floor Control, Inventory Control, manufacturing resource planning and enterprise resource planning.

MODULE 4: Group Technology

Concept, design and manufacturing attributes, part families, composite part, methods of grouping, PFA, classification and coding system- OPITZ– Relevance of GT in CIM, GT and CAD, benefits and limitations of GT.

MODULE 5: Flexible Manufacturing Systems

Flexible & rigid manufacturing cell and FMS structure, types, components of FMS, Building Blocks of FMS, Flexible Assembly System

MODULE 6: Data Acquisition and Database Management Systems

Data acquisition system, type of data, automatic data identification methods, bar code technology, Data and database management system, database design requirements, types of DBMS models-hierarchical, network and relational models and their applications.

Textbooks/ Reference Books:

1. CAD/CAM (Dhan Pat Rai & Sons.) ------ S. Kumar and A.K. Jha
2. Computer Integrated Manufacturing (PHI) ------ S. K. Vajpayee.
3. Mechatronics, HMT Ltd., (Tata Mc Graw Hills)

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE32	Operations Management	3-0-0	3

Course Outcomes (COs):
This course aims to improve students understanding of the concepts, principles, problems, and practices of operations management. After completing this course, students should be able to:

1. To anticipate the importance of productivity and competitiveness to both organizations and nations.
2. To recommend the various production and operations design decisions and to relate them for the overall strategies of organizations.
3. To analyze the relationship of the various planning practices of capacity planning, project planning and scheduling.
4. To summarize the roles of inventories and basics of managing inventories in various demand settings.
5. To relate the contemporary operations and manufacturing organizational approaches and the supply-chain management activities in organizational strategy.

MODULE 1: Operations Management
Introduction, Operations Management and Strategy, Tools for Implementation of Operations.

MODULE 2: Forecasting
Introduction, The Strategic Importance of Forecasting, Benefits, Cost implications and Decision making using forecasting, Classification of Forecasting Process, Methods of Forecasting, Forecasting and Product Life Cycle, Selection of the Forecasting Method, Qualitative Methods of Forecasting, Quantitative Methods, Accuracy of Forecasting

MODULE 3: Inventory Management
Need for holding stock, Planning and controlling stock levels, Product Classification, Demand analysis, ABC analysis, Product Coding. Inventory Cost and Service, Lead Time, Management of Stock Levels, Replenishment Methods

MODULE 4: Layout Planning
Introduction, Objectives of Layout, Classification of Facilities, Why Layout decisions are important, Nature of layout problems, redesigning of a layout, Manufacturing facility layouts, Types of Layouts, Layout Planning, Evaluating Plant Layouts

MODULE 5: Total Quality Management
Introduction, Meaning and Dimensions of Quality, Quality Control Techniques, Quality Based Strategy, Total Quality Management (TQM), Towards TQM – ISO 9000 as a Platform

MODULE 6: Supply Chain Management
Introduction, Domain Applications, Views on Supply Chain, Bullwhip Effect in SCM, Collaborative Supply Chain, Inventory Management in Supply Chain, Financial Supply Chain

MODULE 7: Operations Scheduling
Introduction, Purpose of Operations Scheduling, Factors Considered while Scheduling, Scheduling Activity under PPC, Scheduling Strategies, Scheduling Guidelines,

MODULE 8: Value Engineering
Introduction, Value Engineering/Value Analysis, Relevance of VE in Modern Manufacturing, Process of Value Analysis, VE– Approaches and Aim, Providing Value to the Customers, Benefits

MODULE 9: Project Management
Planning Process: Introduction, need, Project Management Principles, Essentials of Project Management Philosophy, Project Planning, Project Process Flows.

Textbooks/ Reference Books:

1. Heizer, Render, Principles of Operations Management 7th Edition, Prentice Hall, 2008.
2. Heizer, Render, Principles of Operations Management 8th Edition, Prentice Hall, 2011.
3. David Collier and James Evans, OM, 2nd Edition. Upper Saddle River, NJ: South-Western Cengage Learning, 2010/2011. ISBN-13: 978-0538745567
4. Jacobs, F.R. & R. B. Chase. Operations and Supply Chain Management 13th Edition, Boston: McGraw-Hill Irwin, 2010.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE33	**Internal Combustion Engines**	**3-0-0**	**3**

Course Outcomes (COs):

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

1. Analyze and compare the real cycles with ideal air standard cycles to estimate the losses occurring during the run of an I.C. Engine.
2. Apply the properties of fuels and analyses the combustion processes in automotive IC engines including the state-of-the-art technologies of MPFI, CRDI and DGI engines to understand their effect on engine efficiency and emissions.
3. Estimate the primary design parameters, namely, stroke, bore, compression ratio, air-fuel ratio and rated speed of components of internal combustion engines from required performance parameters.
4. Critically examine the causes of unwanted exhaust emissions, their effects on the environment and measures to reduce such emissions from the study of chemistry of combustion and emission control technologies.
5. Estimate the performance of I C engines under various load conditions and throttle positions in a suitable test rig and compare the results for single cylinder and multi-cylinder of I.C. engines, namely SI and CI engines.

MODULE 1:

Fuel Air cycle – effect of variation of specific heats, fuel-air ratio, compression ratio and dissociation. Actual cycle – losses in actual cycle.

MODULE 2:

Exhaust gas analysis – its interpretation and use in determination of combustion characteristics; Pollution norms

MODULE 3:

I C engines fuels - - Petrol, Diesel, natural gases and some other alternative fuels and their characteristics and use in engines. Combustion process in S. I. And C. I. engines, abnormal combustion, detonation and fuel knock – additives. Rating of I. C. engine fuel.

MODULE 4:

Design features of combustion chambers used in S I and C I engines, some important types of combustion chambers.

MODULE 5:

Carburetion – desirable characteristics – compensation for simple jet carburetor, calculation for air-fuel ratio.

MODULE 6:

Injection processes – requirements and methods –mechanical, electronic and MPF injection system.
Ignition processes in petrol engines – requirements and types – battery magneto and electronic.

MODULE 7:
Performance characteristics of petrol and Diesel engines. Part load and full load characteristics in respect to thermal efficiency, mechanical efficiency, fuel consumption, bmep and torque. I C engine ratings and volume capacity compression ratio and weight to power output ratio and its trends in power – weight characteristics. Supercharging of I C engines – effect of supercharging on Diesel and petrol engines – performance characteristics for supercharged engines.

MODULE 8:
Supercharger – types, principles of duel-fuel and multi-fuel engines and Stratified combustion engines.

Textbooks/ Reference Books:

1. A course in Internal Combustion engines, M. L. Mathur and R. P. Sarma, 5th edn, 2014
2. Internal Combustion Engine fundamentals, John B. Heywood, 5th edn, McGraw-Hill international edition, 1988.
3. Internal Combustion Engines, V Ganesan, Tata McGraw Hill Publication, 2nd edn, 2003.
4. Engineering Fundamentals of Internal Combustion Engine, W W Pulkrabek, Pearson Education, 5th Edn. 2013.
5. Fundamentals of Internal Combustion Engine, H.N.Gupta, 2nd Edn, PHI Pvt Ltd, 2013.
6. A textbook of Internal Combustion Engines, S S Thipse, 2nd Rev Edn, Jaico Publishing house, 2014.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE34	**Composite Materials**	**3-0-0**	**3**

Course Outcomes (CO's): After completion of the course, students will be able to

1. Identify different materials to design composites structures.
2. Compare the set of technological properties of the advanced materials with the conventional materials.
3. Use different techniques to process different types of composites and know the limitations of each process.
4. Understand various applications of composite materials in modern industries such as aerospace, automotive, bio-medical etc.
5. Understand different composite testing methods to obtain its material properties.

MODULE 1: Introduction to Composites

Fundamentals of composites, need for composites, enhancement of properties classification of composites, Reinforcement, particle reinforced composites, Fibre reinforced composites. Applications of various types of composites. Fiber production techniques for glass, carbon and ceramic fibers

MODULE 2: Polymer Matrix Composites

Polymer resins- thermosetting resins, thermoplastic resins, reinforcement fibres- various types of fibres. PMC processes- hand layup, spray up, compression moulding, injection moulding, resin transfer moulding, Pultrusion, Filament winding. Fibre reinforced plastics (FRP), Glass Fibre Reinforced Plastics (GFRP), Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Applications of PMC in aerospace, automotive industries

MODULE 3: Metal Matrix Composites

Characteristics of MMC, various types of metal matrix composites, advantages of MMC, limitations of MMC, Reinforcements – particles – fibres. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process, diffusion bonding, stir casting, squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties. applications of MMC in aerospace, automotive industries

MODULE 4: Testing of Composites

Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

Textbooks/ Reference Books:

1. Bhargava, A. K., Engineering Materials: Polymers, Ceramics and Composites, Prentice Hall India.
2. Chawla K. K., "Composite materials", Second Edition, Springer.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818PE35	**Tribology**	**3-0-0**	**3**

Course Outcomes (COs): After completion of the course, students will be able to

1. Understand the fundamentals of tribology and associated parameters.
2. Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.
3. Analyze the requirements and design hydrodynamic and hydrostatic journal and plane slider bearings for a given application.
4. Select proper bearing materials and lubricants for a given tribological application.
5. Apply scientific information and knowledge about tribological problems and solutions to industry.

MODULE 1: Introduction

Introduction, history of tribology, Viscosity, flow of fluids, viscosity and its variation absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers, Tribological considerations, Nature of surfaces and their contact

MODULE 2: Friction and Wear

Role of friction and laws of static friction, causes of friction, theories of friction, Laws of rolling friction; Friction of metals and non-metals; Friction measurements, Friction Instability. Definition of Wear, mechanism of Wear, types and measurement of wear, friction affecting wear, Theories of wear; Wear of metals and non-metals.

MODULE 3: Hydrodynamic theory of lubrication

Principle of hydrodynamic lubrication, Various theories of lubrication, Petroff's equation, Reynold's equation in two dimensions, Effects of side leakage, Reynolds equation in three dimensions, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl, anti-friction bearing, hydrodynamic thrust bearing.

MODULE 4: Hydrostatic lubrication

Principle of hydrostatic lubrication, General requirements of bearing materials, types of bearing materials., Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, Hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing, optimum design of hydrostatic step bearing.

MODULE 5: Lubrication and Lubricants

Importance of Lubrication, Boundary Lubrication, Mixed Lubrication, Full Fluid Film Lubrication, Hydrodynamic, Elasto-hydrodynamic lubrication, Types & Properties of Lubricants, Lubricants Additives, bearing materials, bearing constructions, oil seals, shields and gaskets

Textbooks/ Reference Books:

1. Basu, Sengupta and Ahuja, "Fundamentals of Tribology", PHI
2. Majumdar, B. C, "Tribology", S. Chand Co.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818OE21	**Noise and Vibration Control**	**3-0-0**	**3**

MODULE 1: Noise and Its Measurement
Wave Propagation, Decibel level, Frequency Analysis, Sound pressure level and its measurement, Noise Pollution regulation and control rules, Sound Level Meter.

MODULE 2: Vibration and Its Measurement
Vibration of single and multiple degree(s) of freedom system, Transmissibility, Critical Speed, Dynamical Analogies, Vibration of Beams and plates, Vibration Measurement

MODULE 3: Vibration Control
Vibration control at source, vibration Isolators, Dynamic vibration Absorber

MODULE 4: Acoustics of Rooms, Partitions, Enclosures ad Barriers
Sound field in a room, Acoustics of a Partition wall ad enclosures

MODULE 5: Noise Control Strategies
Control of Noise at source, Control of Noise in the path Control of Noise at the receiver end, Control of Noise of an existing facility

Textbooks/ Reference Books:

1. "Noise and Vibration Control", by M L Munjal, IISc Press, World Scientific Publishing Co. Pte Ltd., Singapore.
2. "Engineering Noise Control" by D.A. Bies, C.H. Hansen, Spon press London
3. Industrial Noise and Vibration Control, by J.D. Irwin, E.R. Graf, Prentice Hall, Englewood Cliffs
4. Notifications issued, time to time, by of GOI regarding Noise/Sound and vibrations

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818OE22	Industrial Safety Engineering	3-0-0	3

Course Outcomes (COs):

On successful completion of this course the student should be able to:

1. Understand the basic concepts and terminologies in industrial safety engineering.
2. Apply various techniques to analyses failure modes.
3. Assess industrial risk and losses.
4. Identify unsafe components in industry and conduct safety audit.
5. Develop fire protection systems in industry.

MODULE 1: Key concepts and basic terminologies

History of Industrial Safety Movement in India and abroad. Basic concepts and importance of industrial safety, key concepts and basic terminologies like safety, risk, accidents, incidents, mishaps, hazards, hazard-mishap entity, examples of hazard components and its description, hazard theory, hazard triangle and hazard analysis, causal factors, hazard actuation, hazard causal factors. Fundamental concepts in safety domain ontology and accident causation.

MODULE 2: Failure modes and effects analysis

Failure modes and effects analysis (FMEA), its history and importance, identification of failure modes, system breakdown concept, methodology and example of a case study of identifying failure modes of compressor sub system.

MODULE 3: Failure tree analysis

Failure tree analysis (FTA), its history and importance, different measures, primary failures, secondary failures, command failures, event symbols, gate symbols with application, failure tree construction concept, P-S-C concept of failure analysis, example of fault tree construction and analysis of gas oven burner system.

MODULE 4: Industrial risk and losses

Concept and definition of industrial risk, risk profile, risk assessment process, risk contour map, individual risk assessment, industrial losses, identification and classification of losses, framework for consequence assessment, loss estimation, safety function deployment and steps of stakeholders concerns about safety.

MODULE 5: Safety audit

Introduction, Components of safety audit, types of audit, audit methodology, non conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

MODULE 6: Industrial Fire Prevention and Protection

Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E – types of fire extinguishers – fire stoppers – hydrant pipes – hoses – monitors – fire watchers – layout of stand pipes – fire station-fire alarms and sirens –

maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills – notice-first aid for burns.

Textbooks/ Reference Books:

1. NPTEL course on "Industrial safety engineering" by Prof. J. Maiti, Department of Industrial and systems engineering, IIT, Kharagpur.
2. Derek, James, "Fire Prevention Hand Book", Butter Worths and Company, London, 1986.
3. R.K.Jain and Sunil S.Rao , Industrial Safety, Health and Environment Management Systems, Khanna publishers , New Delhi (2006).
4. Risk Assessment and Environmental Management: D. Kofi Asvite-Dualy, John Willey & Sons, West Sussex, England (1998).
5. Gupta, R.S., "Hand Book of Fire Technology" Orient Longman, Bombay 1977.
6. GREEN, A.E., "High Risk Safety Technology", John Wiley and Sons,. 1984.
7. Lees, F.P. "Loss Prevention in Process Industries" Butterworths and Company, 1996.

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818OE23	Engineering Economic Analysis	3-0-0	3

Course outcomes (COs):

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

1. Apply the concept of time value of money in managerial decision making
2. Make decisions on economic equivalence of physical assets for selection of alternatives
3. Make decisions on economic replacement of physical assets for acquiring new ones
4. Apply the concept of depreciation for economic decisions on the life of an asset
5. Make decisions on economically viable optimum quantity of production for manufacturing

MODULE 1: Introduction

Introduction to Engineering Economy, Physical & Economic Environment, Phases in Engg. process, Some economic concepts, Value and utility; Interest and Interest rate, Time value of money; Interest formulas: - Simple and compound interest, Cash flow diagrams, Interest formulas for discrete compounding and discrete payments: Single payment (CAF & PWF), Interest formulas for discrete compounding and discrete payments: Equal payment series (CAF, CRF & PWF).

MODULE 2: Problem solving by compounding

Problem solving on discrete compounding, discrete payment; Interest formulas for Uniform gradient series; Interest formulas for geometric gradient series; Compounding frequency of Interest: Nominal and Effective interest rates; Problem solving on frequency compounding of interest and gradient series factors.

MODULE 3: Economic equivalence

Economic equivalence: Meaning and principles of equivalence; Equivalence calculations involving cash flows; Methods of comparison of alternatives: Present worth, Annual equivalent, Future worth, Internal rate of return; Comparison of alternatives: - Capitalized equivalent amount, Capital recovery with return Problem solving on equivalence and comparison of alternatives.

MODULE 4: Replacement analysis

Replacement analysis: Reason, Concept of defender and challenger; Proper treatment of sunk cost in replacement; Replacement because of improved efficiency, inadequacy, demand etc.; Problem solving on replacement analysis; Economic life of the asset.

MODULE 5: Depreciation

Depreciation: Definition, Reasons, Types of property, Value time function and book value; Basic depreciation methods: S-L method, declining balance method; Depreciation: Declining balance switching to S-L, SOYD Method; Modified accelerated cost recovery system (MACRS) method of depreciation, Depletion; Depreciation: Units of production method, Depletion.

MODULE 6: Break even and EOQ

Breakeven analysis, Effect of fixed and variable cost on BEP; Economic order quantity; Problem solving based on Break-even analysis and EOQ.

Textbooks/ Reference Books:

1.Engineering Econmics – H GThuesen and W J Fabryky and G J Thuesen
2.Panneer Selvam, R, ―Engineering Economics‖, Prentice Hall of India Ltd, New Delhi, 2001.
3.Degarmo, E.P., Sullivan, W.G and Canada, J.R, ―Engineering Economy‖, Macmillan, New York, 1984

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818OE24	Automotive Mechanics	3-0-0	3

Course Outcomes (COs): At the completion of the course the student will be able:

1. To apply the concept of internal combustion of fuel air mixture for energy production and subsequent controlled use.
2. To apply various types of engines and sub-systems with respect to desired objective and performance.
3. To examine various, dis-assembled components and assess their condition of components for replacement/repair.
4. To choose primary and peripheral components of an automobile needed for control, safety, comfort, economy and efficiency.
5. To apply new technology in automotive systems for environmental sustainability.

MODULE 1: Introduction

- History of automotive systems and operations, components of an automobile, Basic Engine terminology, Classification of different types of engines.

MODULE 2: Power Unit

Principles of Engine operation, Engine parts and their functions, Multiple cylinder Engines, Engine trouble and repairs.

MODULE 3: Fuel Systems

Fuel used systems for delivery of fuel to the engine, carburetor, fuel pump and injector, common rail system for diesel injection, CRDI.

MODULE 4: Intake and Exhaust Systems

Cylinder head and valves, valve actuation & lubrication, manifold for intake and exhaust, connecting rod, piston, piston rings, gudgeon pin, crankcase, crankshaft and bearings, camshaft and OHC, Timing chains and actuations of valves, VVT engine.

MODULE 5: Power Transmission System

Manual and automatic transmission systems; meaning and functioning. **The clutch**- construction and operation, mechanical versus hydraulic clutch. **Gear box:** types, gear system and gear box, process of speed changing and reversing. **Propeller shaft:** strength consideration and coupling used. **Differential gear box:** need, construction and operation. **Axle and Wheel assembly**: solid/liquid lubrication in bearings, wheel alignment and balancing (castor/camber/toe/ offset). **Tyres-** types, specification, rotation of tyres.

MODULE 6: Chassis and Suspension system

Position of Engine; balance and road holding. Springs (coil and leaf) and dashpots. Steel and rubber bushes and mountings for engine. Chassis construction and types.

MODULE 7: Steering systems

Rack and pinion system, tie rod and wheel pivot, turning radius & safety arrangement. Types: Mechanical system versus hydraulic systems (power steering), Electronic Power Steering (EPS).

MODULE 8: Braking system
Types of Brakes: drum and disc. Brake system: mechanical, pneumatic and hydraulic, and their operation. Components: shoe materials, size and replacement, drum/disc repair and replacement, Antilock Braking system (ABS)

MODULE 9: Recent trends in automobile engineering

Textbooks/ Reference Books:

1. Automotive Mechanics by Crouse and Anglin
2. I C Engines by V Ganeshan
3. Automotive electronics handbook by Ronald K Jurgen, McGraw Hill Professional Publication.
4. Understanding Automotive Electronics by William B. Ribbens, Butterworth-Heinemann, 225 Wildwood Avenue, Woburn, MA 01801-2041.
5. Automobile Electrical and Electronic Systems by Tom Denton, Elsevier Publication

Course Code	Course Title	Hours per week L-T-P	Credit C
ME1818OE25	Machining and Machine Tools	3-0-0	3

Course outcomes (COs):

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

1. Apply cutting tool reference systems in determining tool signatures
2. Apply mechanics of machining as well as chip formation for determination of force, power, toque etc.
3. Evaluate tool life as well as suggest strategies for economic tool life
4. Apply concept of kinematic analysis in machine tool applications
5. Apply design considerations in machine tool applications.

MODULE 1: Introduction and Reference Systems

Machining, definition and objectives. Geometry of cutting tools; turning, milling and drilling - in different reference systems like machine reference system, tool reference system and work reference system.

MODULE 2: Chip Formation and Mechanics

Mechanism of chip formation, Types of chips and their characteristics, Effective rake. Mechanics of machining

MODULE 3: Materials and Failure of Cutting Tools

Cutting tools materials and methods of failure; Assessment of tool life

MODULE 4: Measurement by Dynamometry

theoretical estimation and experimental determination of cutting forces and power consumption. Dynamometers; types, design, construction and use.

MODULE 5: Economics of Machining

Economics of machining and its principal objectives;
Main parameters and their role on cutting forces, cutting temperature, tool life and surface quality, selection of optimum combination of parameters.

MODULE 6: Kinematics of Machine Tools

Basic considerations in the design of drives – Speed and structure program, Ray diagram. Transmission in the systems of stepped regulation. Spindle speed and design of all geared headstock – intermediate shaft diameter calculation. Stepless drives and hydraulic drive. Feed gear boxes.

MODULE 7: Design Considerations

Various types of beds and columns, their materials, construction and design features and principles.
Guides, spindle materials and their lubrication Temperature deformation.
Static and Dynamic rigidity, forced damped, self, excited and stick slip vibration., Vibration isolators.

Textbooks/ Reference Books:

1. Metal cutting: Theory & Practice by Amitabha Bhattacharyya
2. Manufacturing Science by Ghosh and Mallik
3. Metal cutting by E. M. Trent
4. Fundamentals of machining and machine tools**:** Geoffrey Boothroyd
5. Principles of Machine Tools: Sen and Bhattacharya.
6. Design of Machine tools: S. K. Basu.
7. Machine Tool Engineering: G. R. Nagpal.
8. The Design and construction of M/C tools: H. C. Town.
9. Machine Tools Design Hand Books: C.M.T.I.

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