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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