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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