IIT Palakkad

UG Curriculum 2022

BTech Mechanical Engineering

Applicable to all from 2022-23 Academic Year

21 April, 2022

The UG Curriculum and Sample Template for Mechanical Engineering

Program : **Bachelor of Technology**
Department : **Mechanical Engineering**
Year : **2022 Onwards**

The Department of Mechanical Engineering offers a good blend of fundamental knowledge from all the three sub-domains that include Manufacturing, Design and Thermo-fluids. Specially designed program core courses impart fundamental engineering knowledge on basic physical principles of the domain. Further, a wide range of program elective courses deepen their understanding to a sufficient level in the field of their interest. The curriculum also exposes the students to get enough practical experience through various laboratory and project based courses. Overall, the BTech (ME) program at IIT PKD provides a strong base to the students to pursue their curiosity in both academia and industry. The following tables provide the list of program core and elective courses.

List of program core courses:

Level 1
Engineering Thermodynamics, Materials Science and Engineering, Mechanical Measurements: Theory and Practice
Level 2
Dynamics, Fluid Mechanics:Theory and Practice, Manufacturing Processes-I, Mechanics of Solids: Theory and Practice
Level 3
Automation in Manufacturing, Design of Machine Elements, Energy Conversion Systems, Heat and Mass Transfer, Industrial Engineering and Operations Research, Manufacturing Processes-II, Mechanisms and Machines: Theory and Practice, Manufacturing and Materials Engineering Lab, Thermal Engineering Lab
Note: Level 1 courses require no prerequisites while Level 2 and 3 courses may require the prerequisites from Level 1 and 2 courses.

List of program electives that are being currently offered to the senior UG students:

Manufacturing and Materials Engineering
Additive Manufacturing, Advanced Engineering Materials, Advanced Finishing Technologies, Computer Aided Metrology, Digital Manufacturing, Lean Manufacturing, Soft Mechanical Behavior of Materials, Mechanics of Machining, Computing techniques, Surface Degradation and Surface Engineering Processes, Welding Technology
Design
Finite Element Methods, Fracture Mechanics, Fundamentals of Acoustics, Impact Mechanics of Solids, Mechanics and Control of Robotic Manipulators, Solid Mechanics, Continuum Mechanics, Wheeled Mobile Robots
Thermo-fluids engineering
Advanced Heat Transfer, Advanced Refrigeration and Air Conditioning, Aerospace Propulsion, Combustion, Computational Fluid Dynamics, Measurements in Thermo Fluids
Note: Senior UG and Dual Degree students can credit all the Program Elective courses, if they satisfy the prerequisites needed for the course.

The students are advised to follow the suggested mapping of the courses that considered the required prerequisites into the account.

BTech Mechanical Engineering 2022 onwards (Sample Template)

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	I	PH1030	Physics	Institute Core	2-1-0-3
2		MA1011	Linear Algebra and Series	Institute Core	3-1-0-4
3		ME1130	Engineering Drawing	Institute Core	1-0-3-3
4		ID1010	Ecology and Environment	Institute Core	2-0-0-2
5		ID1050A	Engineering Design	Institute Core	1-0-3-3
6		ME1150	Mechanical Workshop	Institute Core	0-0-3-2
7		PH1130/ CY1140	Physics/Chemistry Lab	Institute Core	0-0-3-2
			Total		**19**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	II	MA1021	Multivariable Calculus	Institute Core	3-1-0-4
2		CY1040	Basic Chemistry for Engineers	Institute Core	2-1-0-3
3		HS1010	Technology and Society	Institute Core	2-0-0-2
4		CE1020	Engineering Mechanics	Institute Core	3-1-0-4
5		ID1110	Introduction to Programming	Institute Core	2-0-3-4
6		EE1110	Electrical Workshop	Institute Core	0-0-3-2
7		PH1130/ CY1140	Physics/Chemistry Lab	Institute Core	0-0-3-2
			Total		**21**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	III	ME1020	Engineering Thermodynamics	PMC	3-0-0-3
2		ME2070	Dynamics	PMC	2-0-0-2
3		ME2080A	Materials Science and Engineering	PMC	3-0-0-3
4		ME2090	Mechanical Measurements: Theory and Practice	PMC	1-0-2-2
5		BT2010	Life Sciences	Institute Core	2-0-0-2
6			Humanities and Social Sciences Elective 1	HSE	3
7			Science and Mathematics Elective 1	SME	3
8			Open Elective 1	OE	3
			Total		**21**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	IV	ME2010	Fluid Mechanics Theory and Practice	PMC	3-0-2-4
2		ME2030A	Manufacturing Processes-I	PMC	3-0-0-3
3		ME2012	Mechanics of Solids: Theory and Practice	PMC	3-0-2-4
4			Humanities and Social Sciences Elective 2	HSE	3
5			Science and Mathematics Elective 2	SME	3
6			Open Elective 2	OE	3
			Total		**20**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	V	ME3050A	Heat and Mass Transfer	PMC	3-0-0-3
2		ME3070A	Design of Machine Elements	PMC	3-0-2-4
3		ME3011	Manufacturing Processes-II	PMC	3-0-0-3
4		ME2060A	Mechanisms and Machines: Theory and Practice	PMC	2-0-2-3
5		ME3013	Energy Conversion Systems	PMC	3-1-0-4
6			Program Major Elective 1	PME	3
			Total		**20**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	VI	ME3080	Automation in Manufacturing	PMC	3-0-0-3
2		ME4010A	Industrial Engineering and Operations Research	PMC	3-0-0-3
3		ME3110	Thermal Engineering Lab	PMC	0-0-3-2
4		ME3112	Manufacturing and Materials Engineering Lab	PMC	0-0-3-2
5			Program Major Elective 2	PME	3
6			Program Major Elective 3	PME	3
7			Open Elective 3/Project	OE	3
8			Program Major Elective* (for Honours)	PME*	3
			Total		**19/22**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	VII		Program Major Elective 4	PME	3
2			Program Major Elective 5	PME	3
3			Humanities and Social Sciences Elective 3	HSE	3
4			Open Elective 4	OE	3
5			Project	Project	3

6			Program Major Elective* (for Honours)	PME*	3
7			Program Major Elective* (for Honours)	PME*	3
			Total		**15/21**

Sl No.	Semester	Course Code	Course Title	Category	Credits
1	VIII		Project	Project	6
2			Open Elective 5	OE	3
3			Program Major Elective* (for Honours)	PME*	3
			Total		**9/12**

Total Credits	
Institute Core (IC)	42
Program Major Core (PMC)	48
Program Major Elective (PME)	15
Humanities and Social Sciences Elective (HSE)	9
Sciences and Mathematics Elective (SME)	6
Open Elective (OE)	15
Project	9

Mechanical Engineering

Core course Syllabi

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (Revised)

Course Title	:	Engineering Thermodynamics
Course Code	:	ME1020
Credit	:	3-0-0-3 (L-T-P-C)
Category	:	Core
Target Programme	:	UG
Target Discipline	:	ME
Prerequisite (if any)	:	N/A
Date of proposal	:	27-Nov-2021
Date of approval	:	
Proposing faculty	:	Anand T N C

Course Content:

Fundamentals: System & Control volume; Property, State & Process; Exact & Inexact Differentials (2 lectures)

Work: Thermodynamic definition of work; Displacement work; Path dependence of displacement work and illustrations for simple processes; Other forms of work – electrical, spring and shaft work (3 lectures)

Temperature: Definition of thermal equilibrium, Zeroth law; Temperature scales; Thermometers

Heat: Definition; examples of heat/work interaction in systems (3 lectures)

First Law: Cyclic & Non-cyclic processes; Concept of total energy E; Demonstration that E is a Property; Various modes of energy; Pure substance (5 lectures)

Ideal Gases and ideal gas mixtures: Equation of state, gas constant, mass fraction, mole fraction (3 lectures)

Combustion Fundamentals: Combustion Stoichiometry, Heat of Reaction, Adiabatic Flame Temperature (2 lectures)

Properties of two phase systems: Constant temperature and Constant pressure heating of water; Definitions of saturated states; p-v-T surface; Use of steam tables and R134a Tables; Saturation Tables; Superheated tables; Identification of states & determination of properties (5 lectures)

First Law for Flow Processes: Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; steady flow devices; Unsteady process (4 lectures)

Second Law: Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibilities; Carnot cycle; Absolute temperature scale (5 lectures)

Entropy: Clausius inequality; Definition of entropy S; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables; Principle of Increase of entropy; Illustration of processes in T-S coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles (5 lectures)

Thermodynamic cycles: Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle (3 lectures)

Psychrometry: Wet bulb and dry bulb temperature, relative humidity, humidity ratio, psychrometric charts (2 lectures)

Learning Outcomes:

1. At the end of the course, the students should be able to analyze thermodynamic processes and cycles, and evaluate the performance of thermodynamic systems.
2. Students should be able to identify processes which are feasible, and those which violate the laws of thermodynamics, for macroscopic systems

Text Books:

1. V Babu, Fundamentals of Engineering Thermodynamics, Ane Books, 2nd Edition (2019), ISBN-13: 978-9389212105.
2. C Borgnakke and Richard E Sonntag, Fundamentals of Thermodynamics, Wiley India (2020), ISBN-13: 978-8126598199.
3. P K Nag, Engineering Thermodynamics, McGraw Hill Education; 6th edition (2017), ISBN-13: 978-9352606429.
4. M J Moran, H N Shapiro, D D Boettner and M B Bailey, Principles of Engineering Thermodynamics, Wiley India, 8th Edition (2015), ISBN-13: 978-8126556724.

Reference Books:

5. S R Turns, Thermodynamics: Concepts and Applications, Cambridge University Press, 2nd Edition (2020), ISBN-13 : 978-1107179714.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New/Revised/MOOC)

Course Title : Dynamics

Course Code : ME2070

Credit : 2-0-0-2 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : ME

Prerequisite (if any) : Engineering Mechanics

Date of proposal : 24 November 2021

Date of approval :

Proposing faculty : Sovan Lal Das, Anoop Akkoorath Mana

Course Content:

1. **Vectors and Tensors:** Definition; Coordinate systems, Eigen-values and vectors; Transformation; symmetric, anti-symmetric and rotation tensors; Differentiation. (6 lectures)
2. **Rotation:** Euler's theorem, Euler angles and other representations of rotation tensor, Rotating coordinate systems. (4 lectures)
3. **Introduction to rigid bodies**: Angular velocity; Angular acceleration; Rigid-body kinematics in 3D; Kinematics in a rotating frame; Types of rigid body connections; Kinematics of interconnected rigid bodies (6 lectures)
4. **Rigid-body dynamics in 3D:** Angular momentum, Inertia tensor, Euler's laws, Euler's equations; General planar motion as a special case. (7 lectures)
5. **Applications (select from the list):** Gyroscopes; Flywheels, Balancing, Spacecrafts; Toys; Orbital mechanics. (4 lectures)

Learning Outcomes:

This course will introduce students to the concept of the dynamics of rigid bodies. After taking the course students will be

1. Equipped to derive the equations of motion for rigid bodies and analyse the same.
2. Able to apply the concepts learned, on various engineering systems.

Text/Reference Books:

1. Engineering Mechanics, Volume 2, Dynamics, J.L. Meriam and L.G. Kraige, J Wiley & Sons Inc., ISBN: 9780470614815.
2. Vector Mechanics for Engineers (Dynamics), F.P. Beer and E.R. Johnston Jr., D.F. Mazurek, P.J. Cornwell and B.P. Self, McGraw-Hill Education, ISBN: 9780077687342.
3. Engineering Mechanics, Statics and Dynamics, Irving H. Shames and G.K.M. Rao, Prentice Hall of India, ISBN: 9788177581232.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New/Revised/MOOC)

Course Title : Materials Science and Engineering

Course Code : ME2080A

Credit : 3-0-0-3 (L-T-P-C)

Category : Core

Target Programme : UG

Target Discipline : ME

Prerequisite (if any) : NIL

Date of proposal : 28-11-2021

Date of approval :

Proposing faculty : Kesavan D

Course Content:

Topics	Lectures
Introduction and classification of materials	**2**
Crystal structure: Atomic structure and interatomic bonding. Bravais lattices, unit cells, crystal structures, crystal planes and directions, coordination number. Single crystals, polycrystalline, non-crystalline, nano crystalline materials.	**8**
Imperfections in crystals: Point, line, surface and volume defects.	**4**
Phase diagrams and heat treatment of alloys: Solid solutions, phases, phase diagrams, Fe-Fe_3C system, TTT and CCT curves, phase transformations, diffusion concepts, annealing, normalising, hardening & tempering, hardenability.	**10**
Strengthening mechanisms: Work hardening, solid solution strengthening, precipitation hardening, grain boundary strengthening, transformation hardening.	**2**
Mechanical properties of materials: Hardness, strength, fatigue and fracture.	**2**
Ceramics: Traditional and structural ceramics, mechanical & thermal properties. **Composites:** Types, carbon fiber reinforced plastic, metal matrix composites. **Polymers:** Thermoplastics and thermosets, polymerization methods. **Semiconductors:** Intrinsic and extrinsic semiconductors and microelectronics.	**12**
Manufacturability consideration: formability, weldability, castability & machinability	**2**
Total lectures	**42**

Learning Outcomes:

1. Define fundamental science and engineering principles for materials selection.
2. Correlate the relationship between structure, properties and processing of materials.
3. Apply suitable heat treatment processes to alter mechanical properties of materials.

4. Differentiate various materials properties and methods to alter properties.
5. Analyse manufacturability consideration on selection of materials.

Text/Reference Books: (*Include ISBN Numbers*)

Text books:

i. Engineering Materials: Properties and Selection, Kenneth G. Budinski, Michael K. Budinski, ISBN-13: 978-0137128426

ii. Materials Science and Engineering, an Introduction, William D. Callister. John Willey and Sons Inc. ISBN-13: 978-0470419977

iii. Materials Science and Engineering: A First Course, V. Raghavan, PHI Learning Pvt. Ltd. ISBN-13: 978-8120324558

Reference Books:

i. Physical Metallurgy Principles by Robert E. Reed-Hill, ISBN-13: 978-8176710459

ii. Mechanical Metallurgy, George E Dieter. Mcgraw Hill, London: ISBN-13: 978-1259064791

iii. Introduction to Physical Metallurgy by Sidney H. Avner, New York, McGraw-Hill Edition, ISBN-13: 978-0074630068

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New)

Course Title : Mechanical Measurements: Theory and Practice (New)
Course Code : ME2090
Credit : 1-0-2-2 (L-T-P-C)
(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : Mechanical (ME)

Prerequisite (if any) : Nil

Date of proposal : 28th Nov., 2021

Date of approval :

Proposing faculty : Pramod K and Anoop AM

Course Contents:

Topics	**Lecture/ Practice Hours**
Dynamic Characteristics of Measurement Systems – General structure of a measurement system – Measurement standards and calibration – Propagation of Error and Uncertainty Analysis – General input – output equation – Study of a first and second order system subjected to various inputs (step, ramp, impulse, sinusoidal) – Basic Fourier Series implementation – Basics of Operational Amplifiers: Integrators, Differentiators, Difference amplifiers, etc	3 Hours lecture + 6 Hours practice
Temperature Measurement: Thermometers, resistance temperature detectors, thermocouples etc.	2 Hours lecture + 4 Hours practice
Pressure Measurement: Manometers, pressure gauges, diaphragms, Pitot tubes, etc.	2 Hours lecture + 4 Hours practice
Flow Rate Measurement: Differential pressure devices (Orificemeters, Venturimeters, etc), rotameter, etc.	2 Hours lecture + 4 Hours practice
Measurement of Strain: Strain gauges in various arrangements.	1 Hour lecture + 2 Hours practice
Force Measurement: Weighing balances, load cells, strain gauges, etc. Torque measurement principles	1 Hours lecture + 2 Hours practice
Motion Measurement: Elastic transducers, Linear Vairable Differential Transformer, etc.	1 Hour lecture + 2 Hours practice
Metrology: Comparators and Interferometry	2 Hours lecture + 4 Hours practice
Total	**42 Hours**

Learning Outcomes: Whether it is conducting experiments for R&D, or testing product quality in industry, measurements play a vital role in the life of a mechanical engineer. Also, designing an accurate, consistent measuring device is not as trivial a task as it sounds to be. Thus, this turns out to be a vital as well as an intriguing course. By the theory and practice components of this course,

1. Students are exposed to the theory and general thought process that goes into designing various measurement devices.
2. Students acquire the basic knowledge of classifying the transformation systems and then analysing various simple and complex measurement devices using this classification.
3. It also familiarises the students with the standard process of calibration of various basic measurement devices.

Text/Reference Books: (*Include ISBN Numbers*)

Textbooks

- E. Doebelin, Measurement Systems, 5th Edition, McGraw-Hill Science, 2003 (ISBN: 0072990724, ISBN-13: 978-0072990720)
- S.P. Venkateshan, Mechanical Measurements, 2nd Edition, Ane Books, 2015 (ISBN: 978-1119115564)
- R.S. Figiola and D.E. Beasley , Theory and Design for Mechanical Measurements, 5th Edition, John Wiley and Sons, 2008 (ISBN: 1118881273, ISBN-13: 978-1118881279)
- C.R. Shotbolt and J.F.W. Galyer, Metrology for Engineers, Cengage Learning EMEA, 5th Edition, 1990 (ISBN-10: 0304318442, ISBN-13: 978-0304318445)

Reference Books

- Beckwith, Mechanical Measurements, 6th Edition, Pearson Education, 2007 (ISBN: 8131717186, ISBN-13: 978-8131717189)
- J. P. Holman, Experimental Methods for Engineers, 8th Edition, Mcgraw-Hill, 2011 (ISBN: 0073529303, ISBN-13: 978-0073529301)
- A. S. Morris, Measurement and Instrumentation Principles, 3rd Edition, Butterworth-Heinemann, 2001 (ISBN-13: 978-0750650816)
- J. R. Taylor, An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements,2nd Edition, University Science Books, 1997 (ISBN: 978-0935702750/ 978-0935702422)
- R. A. Gayakwad, Op-amps and Linear Integrated Circuits, 4th Edition, Prentice Hall, 2000 (ISBN: 978-9332549913, 978-9332549913)

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (Revised)

Course Title : Fluid Mechanics - Theory and Practice

(Existing courseME2010FoundationsofFluid Mechanics)

Course Code : ME2010

Credit : 3-0-2-4 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : ME

Prerequisite (if any) : None

Date of proposal : 27/11/2021

Date of approval :

Proposing faculty : Krishana Sesha Giri

Course Content:

Introduction : Introduction, Fluid properties, Basic concepts of fluid flow; Newton's law of viscosity, surface tension (3L+1T)

Basic equations of fluid statics; Manometers; Hydrostatic forces on submerged surfaces; Buoyancy and stability; (5L + 2T + 2P)

Eulerian, Lagrangian approaches to flow definition, Analysis of fluid flow through qualitative visualization (streamlines, streaklines, pathlines, timelines) (2L+2T)

Reynolds Transport Theorem, Integral analysis of fluid motion; Mass conservation, Momentum conservation, Angular Momentum equation, Steady flow energy equation, Static and stagnation pressure, various heads (6L+2T+2P)

Fluid Kinematics: translation - substantial derivative, rotation and deformation, rotational and irrotational vortices (3L+2T+2P)

Differential analysis of fluid motion; Conservation of mass, momentum conservation equations; Derivation of Navier-Stokes equations; Simple flows : Couette and Poiseullie flow solutions; Incompressible inviscid flow: Euler's equation, Bernoulli's Equation (9L+3T+2P)

Dimensional analysis and similitude; Buckingham pi theorem; dimension-less groups in fluid-thermal systems; Flow similarity and model testing (3L+1T)

Potential flows: Line source, sink, irrotational vortex, introduction to superposition (3L+1T)

Internal viscous flows: Flow development; Head loss in a pipe; Major losses – friction factor, Moody's chart; Minor losses; (6L+2T+4P)

Optional topics: External Flows; pressure and viscous drag; Turbulent flows; Compressible flows. (2L)

*The tutorial and practice sessions put together account for 28 hours. The distribution is indicative of typical experiments in the fluid mechanics laboratory

Learning Outcomes:

At the end of the course, the student will be able to

1. Analyse fluid systems at rest and in motion
2. Apply governing equations to simple systems and obtain solutions
3. Design fluid systems for practical engineering applications

Text/Reference Books:

1. Introduction to Fluid Mechanics, 6th Edition, Robert Fox, Alan McDonald, John Wiley & Sons, 2004, **ISBN-13:** 978-0471202318
2. Fluid Mechanics, Frank White, 8th Edition, McGraw Hill, 2017, **ISBN-13:** 978-0073398273
3. Fluid Mechanics, 4th Edition, Pijush Kundu, Ira Cohen, Academic Press 2008, **ISBN-13:** 978-0123737359

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New/Revised/MOOC)

Course Title	:	Manufacturing Processes - I
Course Code	:	ME2030A
Credit	:	3-0-0-3 (L-T-P-C) (Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)
Category	:	Core
Target Programme	:	UG
Target Discipline	:	ME
Prerequisite (if any)	:	Introductory course on materials engineering / metallurgy
Date of proposal	:	25/11/2021
Date of approval	:	
Proposing faculty	:	Buchibabu Vicharapu

Course Content:

Manufacturing:

Topics	**Lecture hours**
Introduction: Manufacturing, product design, material selection, process route, general trends in manufacturing.	2 hours
Casting processes: Basic requirements of casting processes, patterns, mould and core making processes, melting, solidification, risering, gating design, casting defects, and basic numerical problems on casting. Introduction to the special casting techniques (squeeze casting, stir casting, slip casting, vacuum mould casting, evaporative pattern casting, and tape casting).	6 hours
Metal forming processes: Bulk forming (Rolling, forging, drawing, extrusion), and sheet metal working (Bending, Piercing, Blanking), common forming defects and basic numerical problems on forming. Introduction to advanced forming techniques (Hydro forming, explosive forming, electromagnetic forming, and incremental forming)	7 hours
Joining and fastening processes: Welding classification, liquid state and solid state joining processes, welding defects, and basic numerical problems on welding. Soldering and Brazing, testing and inspection of joints.	7 hours
Additive manufacturing: Introduction to additive manufacturing (AM), additive manufacturing of polymers, and metals, defects in AM products.	6 hours
Powder metallurgy: Introduction, powder characterization, blending, compaction of powders, HIP, and sintering.	3 hours
Introduction to micro and nano manufacturing: Film deposition, Lithography, etching, printed circuit boards	3 hours
Polymer processing and composites	5 hours
Property enhancement, post processing, and assembly	3 hours

Total lecture hours	42 hours

Learning Outcomes: At the end of the course, the students should be able to

1. Understand the principles associated with basic operations involving in casting, forming, and welding of engineering materials.
2. Develop skills to manipulate the operating parameters for a given process to avoid defects and improve the product quality.
3. Apply mathematical models to analyze the manufacturing processes.
4. Interpret the advantages and limitations of each manufacturing process and its influence on the properties of the material in the manufactured component.

Text Books:

1. S. Kalpakjian, Manufacturing processes for engineering materials, 6th Edition, Addison Wesley Longman, 2018, ISBN: 978-9353062910.
2. I. Gibson, l D. W. Rosen, l B. Stucker: Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing, Springer New York Heidelberg Dordrecht London. ISBN: 978-1-4419-1119-3.
3. A. Ghosh and A. K. Mallik, Manufacturing Science, 2nd Edition, East-West Press, 2010, ISBN: 78-8176710633.

Reference Books:

1. Milewski, John O, Additive Manufacturing of Metals, From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry, ISBN 978-3-319-58205-4
2. J. Schey, Introduction to Manufacturing processes, 3rd Edition, Tata McGraw Hill, 2000, ISBN: 9780070311367.
3. Mikell, P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 4th Edition, Wiley, 2010, ISBN: 9780470467008.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New/Revised/MOOC)

Course Title : Mechanics of Solids - Theory and Practice

Course Code : ME2012

Credit : 3-0-2-4 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : ME

Prerequisite (if any) : Engineering Mechanics

Date of proposal : 24 November 2021

Date of approval :

Proposing faculty : Sovan Lal Das, KVN Surendra, Anoop Akkoorath Mana

Course Content:

1. **Strength of Materials**: (18 lectures)

   Concept of stress and strain: Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, generalized Hooke's law; analysis of axially loaded members; simple application in design. Pressure vessels (bi-axial stresses).

   Transformation of stress: Transformation of stress; principal stresses; Mohr's circle for stress.

   Torsion: Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation.

   Flexural loading: Shear force and bending moment in beam; flexure formula; differential equation of the elastic curve, deflection of beam.

2. **Theory of Elasticity**: (12 lectures)

   Cartesian Tensors: Introduction to Cartesian tensors, index notation, dyadic product and tensor basis, principal values, symmetric, skew-symmetric, and orthogonal tensors.

   Strain: derivation of small strain tensor, strain compatibility.

   Stress: derivation of Cauchy stress relation at a point. Equilibrium and symmetry equations, principal stresses and directions.

Constitutive Equations: Generalized Hooke's law including thermoelasticity, Material symmetry (this must be introduced in a simplified manner).

3. **Introduction to Boundary Value Problems (BVP)**: (3 lectures)

   Definition of BVP in linear elasticity; concepts of uniqueness and superposition; Governing equations in cylindrical and spherical coordinates, axisymmetric problems.

4. **Special topics**: (9 lectures)

   A selection among the topics listed below may be covered, the list may be expanded depending instructors expertise and interests.

   Plane-stress and plane-strain problems; Curved beams; thermo-elasticity; torsion of non-circular cross section; contact problems in two dimensions; wedge problems; crack-tip fields

5. **Experiments and specialized infrastructure requirement**:

   The course will also have laboratory sessions in addition to the lectures. Experiments are designed to illustrate the concepts taught in the theory lectures. However, lectures on photoelasticity, strain gauges, DIC techniques should be delivered in the lab classes. It is also encouraged that experiments conducted in the lab sessions are taken up as problems in the lectures.

Laboratory Sessions:

Sessions	**Experiment**
1	Application of strain gauge techniques; Lecture on Strain gauges based methods, mounting arrangements of strain gauges for taking readings on normal and shear strains
2	Cantilever beam experiments using strain gauges.
3	Experiments on combined bending and torsion using strain gauges
4	Buckling of Struts
5	Bending of beam (cantilever/simply supported)
6	Study of deformation using extensometer
7	Application of photoelasticity: Demonstration of photoelastic techniques

8	Application of photoelasticity: Calibration of photoelastic techniques, determination of stress field under bending/diametrically opposite loading.
9	Applications of Digital Image Correlation (DIC): Demonstration of DIC techniques, determination of strain fields in the gauge section of a polymer dogbone specimen under tension,
10	Applications of DIC: determination of thermoelastic stress and strain fields using DIC
11	Energy absorption during impact

Learning Outcomes:

The course will introduce the students to the concepts used to study behavior of deformable bodies. After taking the course students will be able to

1. Analyze problems involving uniaxial, biaxial loading, torsion, bending etc using the simplified theory of strength of materials.
2. Solve boundary value problems for solids using small deformation linear elasticity and thermo-elasticity.

Text/Reference Books:

1. Theory of elasticity, S.P. Timoshenko and J.N. Goodier, McGraw-Hill Education (India), ISBN: 9780070701229.
2. Elements of Strength of Materials, Part 1, Elementry Theory and Problems, S.P. Timoshenko, D. Van Nostrand, New York.
3. Applied Mechanics of Solids, Allen F. Bower, Taylor & Francis, ISBN: 9781439802489, Website: solidmechanics.org
4. Elasticity: Theory, Applications, and Numerics, Martin H. Sadd, Elsevier Science, ISBN: 9780080477473.
5. Advanced Mechanics of Solids, L.S. Srinath, Tata McGraw-Hill Publishing Company, ISBN: 9780070139886.
6. Elasticity, J.R. Barber, Springer, 3rd Revised Edition, ISBN: 9789048138081.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (Revised)

Course Title : Heat and Mass Transfer

Course Code : ME3050A

Credit : 3-0-0-3 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : ME (Mechanical Engineering)

Prerequisite (if any) : Fundamentals of Fluid Mechanics and Thermodynamics

Date of proposal : Nov 29, 2021

Date of approval :

Proposing faculty : Samarjeet Chanda

Course Content:

Topics	**Lecture Hours**
Introduction to heat and mass transfer	2
Steady state heat conduction in one and two dimensional systems (slabs, cylinders and spheres); Critical radius of insulation; Fins/ extended surfaces; Introduction to thermal contact interface/spreading resistance, Unsteady state conduction; Lumped system analysis; Concept of semi-infinite media and early and late regimes	8
Convection: Basic governing equations; Boundary layers; Forced convection - External and internal flows; Heat Transfer correlations; Natural convection over external surfaces	12
Analysis of heat exchangers : Parallel, counter and cross flow configurations; concept of LMTD; heat exchange in mixed and unmixed configurations; Design calculations using effectiveness-NTU methods	6
Boiling : Overview of pool and flow boiling processes; boiling curve and concept of critical heat flux; Introduction to the concept of heat pipes; heat transfer correlations; Condensation : Concept of dropwise and filmwise condensation; Nusselt's theory and associated calculation;	5
Radiation heat transfer: Basic laws, Properties of surfaces, view factors, irradiation-radiosity method for surface to surface radiative heat exchange	5

in enclosures (gray – diffuse enclosures), concept of re-radiating surface and radiation shields	
Mass Transfer - Fick's Law of diffusion, one dimensional steady state mass diffusion, Analogous nature of heat and mass diffusion, Convective mass transfer in a boundary layer and its relation to heat transfer	4
Total	42

Learning Outcomes:

1. A first course on heat and mass transfer and the students are expected to learn the basics of this subject and demonstrate ability to design and calculate the heat and mass transfer effects in simple systems.
2. On completing the course the students will be able to comprehend the concepts of heat and mass transfer and apply them to solve engineering problems.

Text/Reference Books: (*Include ISBN Numbers*)

1. F.P.Incropera, and D.P. Dewitt, T. L. Bergman, A. S. Lavine, Fundamentals of Heat and Mass Transfer, Wiley, Seventh Edition, 2011. ISBN-13: 978-0470917855
2. Y A Cengel, A J Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw-Hill, 5th Edition, 2014, ISBN 978-0073398181
3. J. P. Holman, Heat Ttransfer (in SI units), McGraw-Hill, Tenth Edition, 2016. ISBN-13: 9780071069670
4. M Kaviany, Heat transfer physics, Cambridge University Press, 1stEdition, 2008, ISBN 978-0521898973
5. A Bejan, Heat transfer, Wiley India, 1st Edition, 2011, ISBN978-8126530748
6. J R Howell, M P Menguc, R Siegel, Thermal Radiation Heat Transfer, CRC Press, 6th Edition, 2015,ISBN 9781466593268
7. M.N.Ozisik, Heat Transfer : A Basic Approach, McGraw Hill, 1985, ISBN: 9780070479821

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New/Revised/MOOC)

Course Title : Design of Machine Elements

Course Code : ME3070A

Credit : 3-0-2-4 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : ME

Prerequisite (if any) : Engineering Mechanics, Engineering Drawing, Mechanics of Solids:Theory and Practice.

Date of proposal : 24 November 2021

Date of approval :

Proposing faculty : Sovan Lal Das, KVN Surendra

Course Content:

1. Introduction - 1 Lecture
2. General Principles of Machine Design - 2 Lectures
3. Engineering Materials - 3 Lectures
4. Manufacturing Considerations in Design - 2 Lectures
5. Modes of failure and failure theories
    a. Failure under static loading: yield criteria - 2 Lectures
    b. Failure by instability: buckling - 2 Lectures
    c. Fatigue failure: Stress-Life, Strain Life, SN diagram, Endurance Limit, Modification factors, Modified Goodman, Fluctuating loads and combined loading. - 5 Lecture
6. Design of Machine Components (total 25 Lectures)
    a. Fasteners(bolted joints) - 4 lectures
    b. Welded joints - 2 lectures
    c. Helical springs - 4 Lectures
    d. Rolling element bearings - 3 Lectures
    e. Spur and helical gears - 4 Lectures
    f. Shafts, keys - 3 Lectures
    g. Couplings - 2 Lectures
    h. Clutches & Brakes - 3 Lectures

Total - 42 Lectures

Experiments and specialized infrastructure requirement:

The course will also have practice sessions in addition to the lectures. In the practice sessions, students will analyze problems and arrive at the final design of the components. Subsequently, students will make a component drawing using engineering drawing tools and following conventions used in machine drawing. The first few practice sessions will introduce students to the basics of machine drawing.

Laboratory Sessions:

Sessions	Experiment
1	Basic review of machine part drawing, drawing standards (ISS,BIS, ASTM, etc), Fits and tolerances
2	Machine Drawing Practice Session
3	Machine Drawing Practice Session
4	Design of bolted and welded joints
5	Design of helical springs
6	Selection of rolling element bearings
7	Design of spur and helical gear set
8	Design of shafts (considering yield, fatigue, and deflection)
9	Design of clutches and brakes
10	Design course project** involving multiple machine components. Should involve some aspects of system design, such as selection of/deciding on the machine elements involved considering different alternatives to developing a final system with dimensions and bill of materials.
11	
12	

*The sessions should be conducted in the Engineering Drawing room.

** Design course projects may be decided around the middle of the course and the practice sessions 10-12 can be utilized to have discussions on the projects.

Learning Outcomes:

After taking this course, the student will be able to

1. Understand various modes of failure of machine components.
2. Design mechanical components such as springs, bearings, gears, shafts, keys, couplings, clutches and brakes.
3. Understand machine drawing conventions and practices.
4. Make component drawing using engineering drawing tools.

Text/Reference Books:

1. Shigley's Mechanical Engineering Design, R.G. Budynas and K.J. Nisbett, McGraw-Hill Education, ISBN: 9780073398204.
2. Machine Design - An Integrated Approach, R.L. Norton, Prentice Hall, ISBN: 9780135184233.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (Revision)

Course Title	:	Manufacturing Processes - II
Course Code	:	ME3011
Credit	:	3-0-0-3 (L-T-P-C)
Category	:	Core
Target Programme	:	UG
Target Discipline	:	ME
Prerequisite (if any)	:	Engineering Materials, and Manufacturing processes I
Date of proposal	:	27-11-2021
Date of approval	:	
Proposing faculty	:	Dinesh Setti and Kanmani Subbu S

Course Content:

Topic	Lecture Hours
Machining: Introduction, classification, chip formation, orthogonal and oblique cutting, and basic machining operations: shaping, turning, drilling, milling, boring, and grinding.	4
Cutting tools: Types, geometry, nomenclature-ASA, and materials	3
Mechanics of Machining: Surface finish, forces - analysis, Merchant's circle and dynamometry, specific cutting energy, temperature, tool wear and tool life, and economics of the machining.	7
Machine Tools: Motions and surface generation, types of machine tools, constructional features, parts, drives, speed and feed mechanisms.	6
Machine Tools: Type of operations, accessories, attachments, jigs and fixtures, specifications, machining time estimation; Introduction to CNC.	5
Abrasive finishing processes: Lapping, Honing, and superfinishing processes	1
Advanced machining processes: abrasive jet machining, ultrasonic machining, electric discharge machining, laser beam machining, electron beam machining, and electron chemical machining.	3
Metrology: Inspection types and principles, standardization, interchangeability, and selective assembly	1
Measurement of Shapes: Linear and angular measurements, Measurement and gauging of screw threads and gears features, Measurement and quantification, GD&T, and Form measurements: Straightness, flatness, and roundness.	6
Measurement of Surfaces: Surface profile and its characteristics	2
Measurement for Mass Production: Limits, fits and tolerances, Taylor's principles of limit gauging, Design of Limit gauges, Coordinate measuring machines (CMM), Automated CMM, and Introduction to Vision applications in Metrology	4
Total	42

Learning Outcomes:

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

1. Identify and explain the functions of basic components of the lathe, drilling, milling, and grinding machines.
2. Understand the various conventional and advanced machining processes.
3. Explain the speed and feed mechanisms of machine tools.
4. Explain operations performed on machine tools, estimate machining times, and economics of machining.
5. Describe the methods and devices for dimensional, geometric, and surface profile measurement
6. Design of limit gauges.

Textbooks:

1. Manufacturing, Engineering & Technology, Kalpakjian, S. and Steven Schmid, 7th Edition, Pearson, 2014. ISBN: 978-0133128741
2. Fundamentals of Metal Machining and Machine Tools, Geoffrey Boothroyd and Winston A. Knight, 3rd Edition, CRC Press, 2005. ISBN: 978-1574446593
3. Manufacturing Technology: Metal Cutting and Machine Tools, P N Rao, 4th Edition, McGraw Hill Education, 2018. ISBN: 978-9353160524
4. Engineering Metrology, Hume, K. J., 3rd Edition, TBS The Book Service Ltd., 1963. ISBN: 978-0356033372

Reference Books:

1 Machining and Machine Tools, A.B. Chattopadhyay, 2nd Edition, Wiley, 2017. ISBN: 978-8126564743

2 Machining Technology: Machine Tools and Operations, Hassan El-Hofy and Helmi A. Youssef, 1st Edition, CRC Press, 2008.ISBN: 9781420043396

3 Engineering Metrology, I.C. Gupta, Dhanpat Rai & Sons, 2003. ISBN:978-8189928452

4 Metrology for Engineers, Shotbolt, C.S. and Galyer. J., Cassell Publ., 5th Edition, 1990. ISBN: 978-0304318445

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (~~New~~/Revised/~~MOOC~~)

Course Title	:	Mechanisms and Machines: Theory and Practice
Course Code	:	ME2060A
Credit	:	2-0-2-3 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category	:	Core
Target Programme	:	UG
Target Discipline	:	ME
Prerequisite (if any)	:	Engineering Mechanics, Dynamics
Date of proposal	:	24 November 2021
Date of approval	:	
Proposing faculty	:	Santhakumar Mohan, Anoop Akkoorath Mana

Course Content:

1. Kinematic pairs, mobility, mechanisms, and range of movement - 4 lectures
   Grashof's criterion, basic mechanisms, four-bar mechanism and slider-crank mechanism, inversions.
2. Kinematic analysis of planar linkages - 6 lectures
   Displacement, velocity and acceleration analyses, graphical and analytical methods, instant centre, Kennedy's theorem.
   Complex number and computer oriented methods.
3. Dimensional synthesis - 5 lectures
   Introduction to type, number, and dimensional synthesis.
   Function, path and motion generation. Two and three position synthesis, Overlay method, Freudenstein's equation.

4. Dynamics force analysis of planar linkages - 4 lectures

   Static and dynamic force analyses of four-bar and slider-crank mechanisms.

   Static and dynamic balancing of rotating masses, balancing of reciprocating masses and dynamic balancing of single-cylinder engine.

5. Cam mechanisms - 4 lectures

   Cam and follower mechanism and law of cam design. Simple harmonic function, cycloidal motion and polynomial functions. SVAJ diagrams. Practical design constraints of cams.

6. Gears and gear trains - 5 lectures

   Rolling cylinders, law of gearing, pressure angle, gear tooth profile, cycloidal and involute tooth gears. Types of gears. Gear terminology, interference, contact ratio and backlash. Gear trains: Simple, compound, reverted, and epicyclic gear trains.

Total - 28 lectures

Experiments and specialized infrastructure requirement:

The course will also have laboratory sessions in addition to the lectures. The laboratory sessions will involve 3-4 sessions on graphical methods, where students will solve problems on a drawing sheet using engineering drawing tools. Experiments are designed to illustrate the concepts taught in the theory lectures. It is also encouraged that experiments conducted in the lab sessions are taken up as problems in the lectures.

Laboratory Sessions:

Sessions	**Experiment**
1	Position/Displacement analyses of planar mechanisms using graphical method
2	Velocity analyses of planar mechanisms using graphical and instant center methods
3	Acceleration analyses of planar mechanisms using graphical method
4	Kinematic analyses of planar mechanisms using graphical method through CAD software
5	Kinematic analyses of planar mechanism using analytical method through programming software
6	Assembly of mechanisms from links and joints, study of mobility
7	Linkage synthesis, construction and experimental verification

8	Mechanism analysis using mechanism construction kit
9	Mechanism analysis using multi-body dynamic packages
10	Dynamic simulation of planar mechanisms using programming software
11	Analysis of cams and cam profile design/generation
12	Study of gears: Design, assembly and operation of gear trains

*Ordering of laboratory sessions can be adjusted to suit the progress of the course.

Learning Outcomes:

The course will introduce the students to the building blocks of machines, i.e. the various mechanisms that make machines, and their kinematic and dynamic analysis. After taking the course,students

1. Will be equipped to analyze and synthesize the mechanisms and planar linkages.
2. Will have knowledge on various mechanical drives such as linkages, gears, cam and follower and their design aspects.
3. Will have the knowledge to solve initial value problems for motion systems using equations of motions and perform computer based numerical simulations.

Text/Reference Books:

1. Kinematics and Dynamics of Machinery, R.L. Norton, Tata McGraw-Hill, ISBN: 9780070144804.
2. Theory of Machines, S.S. Rattan, Allied Publishers, ISBN: 9788177645927.
3. Theory of Mechanisms and Machines, A. Ghosh and A.K. Mallik, East-West Press, ISBN: 9788185095721.
4. Machines and Mechanisms: Applied Kinematic Analysis, D.H. Myszka, Pearson Education India, ISBN: 9789332555204.
5. Theory of Machines and Mechanisms, J.J. Uicker, G.R. Pennock and J.E. Shigley, Oxford University Press, ISBN: 9780199454167.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New/~~Revised/MOOC~~)

Course Title : Energy Conversion Systems

Course Code : ME3013

(To be provided by the Academic Section, Level should be indicated by the proposer. Example: CE5XXX for a 5000 level course in Civil Engineering)

Credit : 3-1-0-4 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : ME

Prerequisite (if any) : Fluid Mechanics and Engineering Thermodynamics

Date of proposal : 27-11-2021

Date of approval :

Proposing faculty : Pramod Kuntikana

Course Content:

Topics	**Lecture Hours**
Combustion fundamentals and IC Engines – Brief overview of Combustion, Engine components and classifications; Working Principle and Actual Cycles; Combustion in SI and CI engines, Combustion stages, Combustion chambers and Abnormal combustion, Emissions Formation and Control; Engine Systems; Engine Testing- Performance and Emissions.	17 lecture hours + 5 tutorial hours
Turbomachines: Brief overview of compressible and nozzle flows, Classifications of turbomachines, Working of Axial and Radial Turbines (Gas, Water, Steam, Wind), Compressors, Blowers, Pumps and fans, Application of first and second laws of thermodynamics to turbomachines and the concept of efficiency of turbomachines. Velocity triangles, Euler equation for turbomachines, Concept of degree of reaction, Outline of different losses. Similitude Analysis. Performance of turbomachines, system characteristics and operating point.	15 lecture hours + 6 tutorial hours
Refrigeration and Air Conditioning: Vapour compression and vapour absorption cycles, Actual cycles - superheating, sub-cooling and multi-staging and cascading. Refrigerant properties and selection; Brief overview of psychrometry, Air-conditioning processes	10 lecture hours + 3 tutorial hours
Total	**56 hours**

Learning Outcomes: By the completion of this course students are expected to acquire the ability to

1. Understand the classification, components, working, and key design aspects of various energy conversion systems with real life engineering applications
2. Conduct the performance characterization of IC Engines and Turbomachines and to plot the characteristic curves
3. Have a good idea of the different space cooling systems such as domestic refrigerators and air conditioners

Text/Reference Books: (*Include ISBN Numbers*)

Applied Thermodynamics

1. M. J. Moran, H.N. Shapiro, D. D. Boettner, and M. B. Bailey, Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 2010. (ISBN: 0470495901, ISBN-13: 978-0470495902)
2. T.D. Eastop, Applied Thermodynamics for Engineering Technologists, Pearson India, 2002. (ISBN: 9788177582383, ISBN-13: 978-8177582383)

Combustion and IC Engines

3. S. R. Turns, An Introduction to Combustion Concepts and Applications, McGraw Hill, 2010 (ISBN: 9781259025945, 9781259025945)
4. B. P. Pundir, IC Engines: Combustion and Emissions, Narosa Publishing House, New Delhi, 2017 (ISBN: 9788184870879)
5. J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill International Editions, 2018. (ISBN: 9781260116106)
6. Richard Stone, Introduction to Internal Combustion Engines, 4th Edition, Palgrave Macmillan, 2012. (ISBN: 0768020840 / 9780768020847)
7. Mathur M. L and Sharma. R. P, A Course in Internal Combustion Engines, Dharpat Rai & Sons, 2010. (ISBN: 8189928465)

Turbomachines

8. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachines, 4th edition, Butterworh Hinemann, 2013. (INBN: 9780124159549)
9. Gopalakrishnan, G. and Prithvi Raj, D. A Treatise of Turbomachines, Scitech Publications, 2002 (ISBN: 8187328983/ 9788187328988)
10. Kadambi, V. and Manohar Prasad, An Introduction to Energy Conversion Vol.III: Turbomachinery, New Age International Private Limited, 2011 (ISBN: 8122431895/9788122431896).

Refrigeration and Air Conditioning

11. Arora CP, Refrigeration and Airconditioning, Tata McGraw-Hill Education, 2017 (ISBN: 9351340163, 9789351340164)
12. Manohar Prasad, Refrigeration and Airconditioning, New Age International Pvt. Ltd., 2015. (ISBN: 9788122436945)
13. Gosney WB, Principles of Refrigeration, Cambridge University, 1982 (ISBN: 9780521236713/ 0521236711)
14. Stoecker WF and Jones JW, Refrigeration and Air Conditioning, Tata McGraw Hill, 2014 (ISBN: 9789332902954)

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (Revised)

Course Title	:	**AUTOMATION IN MANUFACTURING**
Course Code	:	ME3080
Credit	:	3-0-0-3 (L-T-P-C)
Category	:	Core
Target Programme	:	UG
Target Discipline	:	ME
Prerequisite (if any)	:	Manufacturing Processes
Date of proposal	:	28-11-2021
Date of approval	:	
Proposing faculty	:	Chakradhar Dupadu

Course Content:

Topic	Lecture (Hrs)
Introduction to Automation: Basic elements of an automated system, Advanced automation functions, Levels of automation, Automation in production systems, Process industries versus discrete manufacturing industries, Fourth industrial revolution, Smart factories, Smart Manufacturing.	8
Industrial control: Computer process control, Forms of computer process control, Discrete process control, Ladder logic diagrams, Programmable logic controllers, NC part programming, sensors, actuators and other control system components.	6
Industrial Robotics: Robot anatomy and related attributes, robot controls systems, end effectors, sensors in robots, industrial robot applications.	6
Material Handling: Overview of material handling equipment, Considerations in material handling system design, 10 principles of material handling, Industrial trucks, Automated guided vehicle systems, Monorails and other rail guided vehicles, Conveyor systems, Cranes and Hoists, Analysis of material transport systems, Automatic data capture.	6
Manufacturing Systems: Single station manned workstations, Single station automated cells, Analysis of single station systems, Group Technology, Cellular manufacturing, Quantitative analysis in cellular manufacturing. Flexible manufacturing systems, Analysis of Flexible Manufacturing Systems.	12
Transfer lines and similar automated manufacturing systems: Fundamentals of automated production lines, application of automation production lines, Analysis of transfer lines.	4

Learning Outcomes:

1. Plan automated systems to improve manufacturing productivity using robots, numerical control machines, programmable controllers, computer controllers.
2. Analyze automated material transport systems on the shop floor.
3. Understand about various components of automation like sensors, actuators, PLC.
4. Understand transfer lines and advanced industrial automation.

Text Books:

1. Mikell P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, 4th Edition, Pearson, 2016, ISBN-13: 978-0132393218

Reference books:

1. C. Ray Asfahl, Robots and Manufacturing Automation, 2nd Edition, Wiley, 1992, ISBN: 978-0-471-55391-5
2. P. Radhakrishnan, S. Subramanyan, V. Raju, CAD/CAM/CIM, 2nd Edition, New Age International, 2008, ISBN: 9788122412482

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New)

Course Title	:	Industrial Engineering and Operations Research
Course Code	:	ME4010A
Credit	:	3-0-0-3 (L-T-P-C)
Category	:	Core
Target Programme	:	UG
Target Discipline	:	ME
Pre-requisite (if any)	:	Preliminary knowledge about probability and statistics
Date of proposal	:	22-11-2021
Date of approval	:	
Proposing faculty	:	Dinesh Setti

Course Content:

Topic	Lecture Hours
Introduction to Industrial Engineering and Operations Research; Production and Productivity - measurement;	3 hours
Facility Design: Facility location factors and evaluation of alternate locations, Types of plant layout and their evaluation.	3 hours
Production Planning: Forecasting models, aggregate production planning, scheduling, materials requirement planning.	6 hours
Quality control: Statistical process control, process capability, acceptance sampling.	4 hours
Work System Design: Method study, Micro-motion study, Principles of motion economy; Work measurement – Time study, Work sampling.	3 hours
Inventory Control: Inventory – functions, costs, classifications, deterministic inventory models, quantity discount, stochastic inventory models.	6 hours
Operations Research 1: Linear programming, simplex method, integer programming, mixed-integer linear programming, transportation, assignment models.	11 hours
Operations Research 2: Network flow models, PERT and CPM, simple queuing models.	6 hours
Total	42 hours

Learning Outcomes:

1. Provide a broad overview of the important topics in IE and OR, and develop understanding about problems and algorithms, using examples.
2. Apply the knowledge of IE and OR concepts to articulate real-world decision situations for identifying, analyzing, and practicing strategic decisions to counter the consequences.
3. Provide students with the art and science of using software tools to model and solve optimization problems.

Textbooks:

1. Production Planning and Inventory Control, S. L. Narasimhan, D. W. McLeavey, and P. J. Billington, 2nd Edition, 2007, Prentice Hall, ISBN 8120311388
2. Handbook of Industrial Engineering, G. Salvendy, 3rd Edition, 2007, Wiley, ISBN 0470241829.
3. Industrial Engineering and Management, S. C. Sharma and T. R. Banga, 1st Edition, 2017, Khanna Publishing, ISBN 9789386173072.
4. Operations Research: An Introduction, H. A. Taha, 9th Edition, 2014, Pearson Education India, ISBN 933251822X.

Reference Books:

1. Factory Physics, W. J. Hopp and M. C. Spearman, 3rd Edition, 2011, Waveland Press, ISBN 1577667395.
2. Maynard's Industrial Engineering Handbook, H. Maynard and K. Zandin, 5th Edition, 2001, McGraw-Hill Education, ISBN 0070411026.
3. Operations Management, J. Heizer, B. Render, C. Munson, and A. Sachan, 12th Edition, 2017, Pearson, ISBN 9789332586703.
4. Operations Management, W. J. Stevenson, 12th Edition, 2021, McGraw-Hill Education, ISBN 9390727464.

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (New)

Course Title : Thermal Engineering Lab

Course Code : ME3110

Credit : 0-0-3-2 (L-T-P-C)

(Weekly hours for L- lecture, T-Tutorial, P - Laboratory, C - total course credit)

Category : Core

Target Programme : UG

Target Discipline : Mechanical (ME)

Prerequisite (if any) : Courses on Energy Conversion Systems and Heat and Mass Transfer

Date of proposal : 28-11-2021

Date of approval :

Proposing faculty : Anand, Samarjeet, Krishna, Ganesh and Pramod

Course Content:

Topics	Practice Hours
Basic experiments on heat conduction: Linear heat conduction, Thermal conductivity measurement of solids and powders, Critical radius of insulation	6 Hours
Convective heat transfer experiments: Forced and free convection over fins, Parallel and counter flow heat exchangers, Boiling and condensation	6 Hours
Radiation heat transfer: Lambert's law and Stefan Boltzmann's law experiments	4 Hours
Refrigeration and air-conditioning: Vapour compression cycle test, Air conditioning performance evaluation test	4 Hours
IC Engines: Performance and emission testing for engines, Combustion analysis, Morse test for multi-cylinder engines	6 Hours
Turbines: Performance testing of turbines (Pelton wheel/ Kaplan turbine/ Francis turbine)	6 Hours
Pumps: Performance testing of pumps (centrifugal/ piston pump/ jet pump/ gear pump)	6 Hours
Performance testing of air compressors and blowers	4 Hours
Total	**42 Hours**

Learning Outcomes: Students who successfully complete the course must be able to demonstrate an ability to:

1. Perform basic heat transfer experiments to determine the thermal conductivity of any solid, the heat transfer coefficient for fluid flows and the emissivity of an unknown Gray surface.
2. Experimentally determine the of effectiveness of heat exchangers
3. Determine the practical COP of Refrigerators and Air-Conditioners
4. Carry out performance and emission testing of IC Engines

5. Obtain the performance characteristics for turbomachines such as compressors, blowers, pumps and turbines

Reference Books: (*Include ISBN Numbers*)

References:

1. M Kaviany, Heat transfer physics, Cambridge University Press, 1stEdition, 2008, ISBN 978-0521898973
2. Arora CP, Refrigeration and Airconditioning, Tata McGraw-Hill Education, 2017 (ISBN: 9351340163, 9789351340164)
3. Mathur M. L and Sharma. R. P, A Course in Internal Combustion Engines, Dharpat Rai & Sons, 2010. (ISBN: 8189928465)
4. Kadambi, V. and Manohar Prasad, An Introduction to Energy Conversion Vol.III: Turbomachinery, New Age International Private Limited, 2011 (ISBN: 8122431895/9788122431896).
5. H. Je-Chin, L. M. Wright. Experimental Methods in Heat Transfer and Fluid Mechanics. CRC Press, 2020 (ISBN: 978-0367897925)
6. R. A. Granger, Experiments in Heat Transfer and Thermodynamics, Cambridge University Press, 1994 (ISBN: 978-0521449250)
7. J. P. Holman, Experimental Methods for Engineers, 8th Edition, Mcgraw-Hill, 2011 (ISBN: 0073529303, ISBN-13: 978-0073529301)

INDIAN INSTITUTE OF TECHNOLOGY PALAKKAD

Proforma for proposing course (Revised)

Course Title : Manufacturing and Materials Engineering Laboratory

Course Code : ME3112

Credit : 0-0-2-2 (L-T-P-C)

Category : Core

Target Programme : UG

Target Discipline : B. Tech

Prerequisite (if any) : Nil

Date of proposal : Nov 29, 2021

Date of approval :

Proposing faculty : Dr. Afzaal Ahmed, Dr. Kesavan D, Dr. Kanmani Subbu, Dr. D. Chakradhar, Dr. Dinesh Setti, Dr. Buchibabu V

Course Content:

S. No.	Topic	Sessions
1	Heat treatment of plain carbon / alloy steels: Annealing, normalising, hardening and tempering studies.	1
2	Effect of rolling and annealing on recovery, re-crystallization & grain growth of aluminium / copper alloys.	1
3	Quantitative metallography to evaluate case depth, inclusion count, secondary phases and reinforcement in metals / composites.	1
4	Effect of current, voltage and welding speed on weld bead profiles during gas metal arc welding	1
5	Effect of polarities (DCEN, DCEP) on weld bead profiles during gas metal arc welding	1
6	Study the effect of layer thickness and infill density on the density of the part in the additive manufacturing process	1
7	Effect of turning process parameters on surface roughness under sustainable cooling environments	1
8	Indexing and spur gear cutting.	1

9	Effect of process parameters on surface finish in grinding.	1
10	Effects of various operating parameters on machining performance in die sink EDM	1
11	Measure the linear and angular dimensions and draw the required orthographic projection views of the given part	1
12	Measurement of scanning width by optical proximity switches in MPS measuring station.	1
	Total	12

Learning Outcomes: At the end of the course, the student shall be able to

1. Correlate the relationship between structure, properties and processing of materials.
2. Suggest appropriate methods/process to fabricate different geometrical feature on the workpiece to obtain final product.
3. Analyse the effect of various machining/grinding/welding parameters on the outcome of the process performance.

Text Books:

1. Workshop technology, Vol. II, Chapman W.A.J, CBS Publisher, 2007. ISSN: 978-8123904115
2. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Grover M.P., John Wiley & Sons. 2001. ISSN: 978-0471400516

Reference Books:

1. Elements of Workshop Technology, Vol. II, Hajra Chowdary, S.K., and Hajra Chowdary, A.K., Asia Publishing House, Bombay, 2010. ISBN:978-8185099156.