Curriculum for Undergraduate Degree (B.Tech.) in Mechanical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Fifth Semester

Course Name:	**Heat Transfer**		
Course Code:	PC-ME501	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Knowledge of Engineering Thermodynamics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2	Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3	The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers and mass transfer in introductory level.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Module 1: Conduction Heat Transfer** Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.	14L
2	**Module-2: Convective Heat Transfer**	

	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer- Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	10L
3	**Module-3: Radiation Heat Transfer** Interaction of radiation with materials, definitions of radioactive properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.	9L
4	**Module-4: Heat Exchanger** Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε - NTU methods.	7L
5	**Module-5: Boiling and Condensation** Boiling and Condensation heat transfer, Pool boiling curve.	4L
6	**Module-6: Mass Transfer** Introduction to mass transfer, Similarity between heat and mass transfer.	4L
Total		**48L**

Course Outcomes:
After completion of the course, students will be able to:
1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer. 2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer. 3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Learning Resources:	
1	A. Bejan, Heat Transfer, John Wiley, 1993.
2	J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3	F.P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6th Edition,

	John Wiley, 2007.
4	M. Kaviany, Principles of Heat Transfer, John Wiley, 2002
5	Y.A. Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002
6	Advaced differential equation-M.D. Raisinghania, S. Chand Publication

Course Name:	**Solid Mechanics**		
Course Code:	PC-ME502	**Category:**	Professional Core
Semester:	Fifth	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Basic knowledge of Engineering Mechanics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The objective is to present the mathematical and physical principles in understanding the linear continuum behaviour of solids.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Module 1:** Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions	12L
2	**Module 2:** Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.	10L
3	**Module 3:** Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.	10L
4	**Module 4:** Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-D contact problems	9L
5	**Module 5: Enzymes:** Solutions using potentials. Energy methods. Introduction to plasticity.	7L

Total	**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries

Learning Resources:	
1	G.T. Mase, R.E. Smelser and G.E. Mase, Continuum Mechanics for Engineers, 3rd Edition, CRC Press, 2004.
2	Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3	L.E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall International, 1969.
4	Biology for Engineers. G. K. Suraishkumar. Oxford

Course Name:	**Kinematics and Theory of Machines**		
Course Code:	PC-ME 503	**Category:**	Professional Core Courses
Semester:	Fifth	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Engineering Mechanics & Strength of Materials
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
2	To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
3	To be able to design some linkage mechanisms and cam systems to generate specified output motion.
4	To understand the kinematics of gear trains.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Module 1:** Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains. Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms**.**	6L
2	**Module 2:** Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Corioli's component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation**.**	8L
3	**Module 3:** Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics**.**	8L
4	**Module 4:** Definition & types of vibration; differential equations of vibratory motions (longitudinal & torsional); Natural frequency of free longitudinal vibration-equilibrium method, energy method (Rayleigh's maximum energy principle); effect of inertia in longitudinal vibration; Natural frequency of free transverse vibration of a beam due to point loads - Rayleigh's method; Whirling of shaft, synchronous whirling; critical speed; Dunkerley's method, free damped vibration; damping factor; logarithmic decrement; Forced vibration, concept of under damped, critically damped and over damped system; Dynamic magnifier (magnification factor); vibration isolation and transmissibility	10L
5	**Module 5:** Balancing of Reciprocating and Rotating Masses- Static balancing, Unbalance of force or moment, Dynamic balancing of rotating masses- graphical and analytical methods; Swaying couple; Hammer blow.	6L
6	**Module 6:** Governors- Use and classification; Study and analysis of Porter, Proell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors.	3L
7	**Module 7:** Inertia force and inertia torque in reciprocating engine, correction couple (torque), Turning moment diagram and flywheel design.	3L
8	**Module 8:** Gyroscope- Gyroscopic couple and precessional motion, Effect of gyroscopic couple on aeroplane and ship, Stability of two wheel and four wheel vehicles taking turn.	4L

Total	**48L**

Course Outcomes:
After completion of the course, students will be able to:
The students can design various types of linkage mechanisms for obtaining specific motion and analyze them for optimal functioning.

Learning Resources:	
1	T. Bevan, Theory of Machines, 3rd Edition, CBS Publishers & Distributors, 2005.
2	A. Shariff, Theory of Machines, Dhanpat Rai Publication, New Delhi, 2000.
3	W.L. Cleghorn, Mechanisms of Machines, Oxford University Press, 2005.
4	R.L. Norton, Kinematics and Dynamics of Machinery, 1st Edition, McGraw Hill India, 2010.
5	A. Ghosh and A.K. Mallick, Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.

Course Name:	**Effective Technical Communication**		
Course Code:	HM-HU 502	**Category:**	Humanities and Social Sciences
Semester:	Fifth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The course aims to teach students the principles of technical communication for their academic and professional needs, focusing on essential written and oral skills for presenting technical information effectively.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Module 1***:* Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.	7L
2	**Module 2***:* Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of	8L

	grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.	
3	**Module 3***:* Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity	6L
4	**Module 4***:* Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	8L
5	**Module 5***:* Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.	7L
Total		**36L**

Course Outcomes:
After completion of the course, students will be able to:
1. Understand the dynamics of Verbal and Non Verbal aspects of technical communication 2. Practice multi-step writing process to plan, draft, and revise reports, correspondence, and presentations. 3. Illustrate and examine the knowledge of ethical aspects of engineering 4. Demonstrate and explain social and professional etiquettes 5. Plan self-development and practice self-assessment to function on multi-disciplinary teams.

Learning Resources:	
1	D.F. Beer and D. McMurrey, Guide to Writing as an Engineer, John Willey, New York, 2004
2	D. Hacker, Pocket Style Manual, Bedford Publication, New York, 2003.
3	S. Khera, You Can Win, Macmillan Books, New York, 2003.
4	R. Sharma, Technical Communications, Oxford Publication, London, 2004.
5	D. Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004.
6	R. Sharma and K. Mohan, Business Correspondence and Report Writing, 5th Edition,

	McGraw Hill Education, 2017.
7	Xebec, Presentation Book, McGraw Hill Education India, New Delhi, 2000

Course Name:	**Aptitude Skill Development-I**		
Course Code:	MC 571	**Category:**	Mandatory course
Semester:	Fifth	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Mathematics and English Language
Full Marks:	100		
Examination Scheme:	Semester Examination: 100	Continuous Assessment: 00	Attendance: 00

Course Objectives:	
1	To be familiar with the basic concepts of QUANTITATIVE ABILITY.
2	To be familiar with the basic concepts of LOGICAL REASONING Skills.
3	To be familiar with the basic concepts of PROBABILITY.
4	Acquire knowledge in VERBAL REASONING and VOCABULARY

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Basics of Quantitative Abilities: Number System, HCF and LCM, Average, Ratio, Proportion and Variations, Problems on Percentage.	4L
2	Arithmetic Quantitative Abilities: Problems on Ages, Profit and Loss, Time and Work, Problems on Simple and Compound Interest, Problems on Time, Speed and Distance.	6L
3	Permutation and Combination, Set theory, Mensuration and Logarithm.	5L
4	Logical Reasoning: Number Series, Alpha Numerical, Letter & Symbol Series, Numerical and Alphabet Puzzles, Seating Arrangement, Blood Relation and Calendars.	7L
5	Data Interpretation	2L
Total		**24L**

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

1. Understand the basic concepts of QUANTITATIVE ABILITY.
2. Understand the basic concepts of LOGICAL REASONING Skills.
3. Understand the basic concepts of PROBABILITY.
4. Acquire satisfactory competency in use of VERBAL REASONING

Learning Resources:	
1	Arun Sharma, "Quantitative abilities", McGraw-Hill
2	R. S. Agrawal, "Quantitative Aptitude for Competitive Examinations", S. Chand
3	R. S. Agarwal,"A Modern Approach to Verbal & Non-Verbal Reasoning ",S. Chand

Course Name:	**Mechanical Engineering Laboratory-I (Thermal)**		
Course Code:	PC-ME591	**Category:**	Professional Core Courses
Semester:	Fifth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Engineering Thermodynamics, Fluid Mechanics and Fluid Machines
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the principles and performance characteristics of flow and thermal devices.
2	To know about the measurement of the fluid properties.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Measurement of coefficient of discharge of given Orifice and Venturi meters.	3P
2	Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe.	3P
3	Determination of the performance characteristics of a centrifugal pump.	3P
4	Determination of the performance characteristics of Pelton Wheel	3P
5	Determination of the performance characteristics of a Francis Turbine.	3P
6	Determination of the performance characteristics of a Kaplan Turbine.	3P

7	Determination of the thermal conductivity and specific heat of given objects.	3P
8	Determination of the calorific value of a given fuel and its flash & fire points.	3P
9	Determination of the p-V diagram and the performance of a 4-stroke diesel engine.	3P
10	Determination of the convective heat transfer coefficient for flow over a heated plate.	3P
11	Determination of the emissivity of a given sample.	3P
12	Determination of the performance characteristics of a vapour compression system.	3P
Total		**36P**

Course Outcomes:
After completion of the course, students will be able to:
The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery.

Learning Resources:	
1	Laboratory manual

Course Name:	**Machine Drawing-II**		
Course Code:	PC-ME592	**Category:**	Professional Core Courses
Semester:	Fifth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Engineering Drawing in Manual & AUTOCAD form
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Students have an ability to apply knowledge of Modeling, science & engineering.
2	Student can modeled this drawing even in CAD/CAM software by applying the basic knowledge of machine drawing.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	**Module 1: Projection and Isometric Drawing of Machine components** **Fasteners:** Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts. Riveted joints: Forms and proportions of river heads, Different views of different types of riveted Lap and Butt joints. **Drawings of various views of Shaft joints:** Cotter joint and Knuckle joint. Keys & Shaft coupling: Muff, Flanged, Flexible, Universal and Oldhams coupling.	12P
2	**Module 2: Assignments using graphic software (CATIA)** **Assembly and detailed drawings:** Tool head of a shaping machine; Engine parts: Eccentric, Piston, Cross head and Connecting rod; Valves: Steam stop valve, Anyone of safety, relief and non-return valves; Solid modeling of Plummer block	24P
**Each of module composed of six assignments (Total: 12 assignments)		
Total		**36P**

Course Outcomes:
After completion of the course, students will be able to:
1. Understand and apply the knowledge of machine drawing as a system of Communication in which ideas are expressed clearly and all information fully conveyed. 2. To understand the design a system, component or process to meet desired needs within, realistic constraints such as manufacturability, economic, environmental, safety & sustainability etc., to represent a part drawing and assembly drawings. 3. To identify, formulates, analyzes and solve Engineering Problems in Optimum time.

Learning Resources:	
1	Laboratory manual

Course Name:	**Project-I**		
Course Code:	PW-ME581	**Category:**	Project (Summer internship)
Semester:	Fifth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination (Viva-voce form): 100	Continuous Assessment: 00	Attendance: 00

Course Objectives:	
1	This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Course Outcomes:
After completion of the course, students will be able to:
Students will be able to gather some exposure on some projects, may be designing some innovative ideas, fabricating and/or demonstrating an innovative machine or product, etc.