Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP502
Course Name	Thermodynamics and combustion
Desired Requisites:	Requisite Courses: Basic Mathematics, Chemistry

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	Students will get Knowledge of exergy, basic laws governing energy conversion in multicomponent systems and application of chemical thermodynamics.
2	Student will be aware about advanced concepts in thermodynamics with emphasis on the thermodynamic relations, equilibrium and stability of multiphase multi-component systems
3	Student will be acquire the confidence in analyze the motion of combusting and no combusting fluids whilst accounting for variable specific heats, non-ideal gas properties, chemical no equilibrium and compressibility

Course Outcomes (CO)

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand the concepts of thermodynamics and kinetics of combustion	II	Understand
CO2	Apply the concepts of Thermodynamics and combustion phenomena in energyconversion devices.	III	Apply
CO3	Analyse the combustion mechanisms of various fuels.	IV	Analyse

Module	**Module Contents**	**Hours**
I	First law and State postulates, Second law and Entropy, Availability and Irreversibility, Transient flow analysis	7
II	Nonreactive Ideal-Gas Mixture, PVT Behaviour of Real gases and Real Gas mixture	7
III	Generalized Thermodynamic Relationship	7
IV	Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium	7
V	Statistical thermodynamics, statistical interpretations of first and second law and Entropy.	6

VI	Third law of thermodynamics, Nernst heat theorem	6

Text Books

1	An Introduction to Thermodynamics, Y.V.C. Rao, University Press (India) Private Limited,Revised Edition, 2004).
2	Thermodynamics: an Engineering Approach, Y.A.Cengal and M.A.Boles, McGraw Hill (Fifthedition).
3	Fundamentals of Classical Thermodynamics, G.VanWylen, R.Sonntag and C.Borgnakke , John Willey & Sons (Fourth edition).

References

1	Cengel, "Thermodynamics", Tata McGraw Hill Co., New Delhi, 1980.
2	Howell and Dedcius, "Fundamentals of Engineering Thermodynamics", McGraw Hill Inc., U.S.A
3	Van Wylen& Sonntag, "Thermodynamics", John Wiley and Sons Inc., U.S.A
4	Jones and Hawkings, "Engineering Thermodynamics", John Wiley and Sons Inc., U.S.A, 2004.
5	Holman, "Thermodynamics", McGraw Hill Inc., New York, 2002.
6	Faires V.M. and Simmang, "Thermodynamics", Macmillan Publishing Co. Inc., U.S.A.
7	Rao Y.V.C., "Postulational and Statistical Thermodynamics", Allied Publishers Inc, 1994

Useful Links

1	https://youtu.be/lvy8h-yWhRQ
2	https://youtu.be/JIDK5iyatBk
3	https://youtu.be/EYKeBg4DmHI

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2			
CO2		1			3	
CO3			2	3		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP503
Course Name	Advanced Fluid Dynamics
Desired Requisites:	Fluid Mechanics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To enable the students to analyze and solve fluid related problems by applying principlesof mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfil industrial needsrelated to fluid dynamics.
3	To train students with effective communication skill to demonstrate fluid dynamicstheories.
4	To develop skills in the analysis of fluid systems with mathematical modeling forapplications of fluid dynamics in research or design.
5	To develop a professional approach for lifelong learning in the fluid dynamics to includethe awareness of social and environment issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand and define the fluid flow problems along with range of governing parameters	II	Understand
CO2	Devise the experiments in the field of fluid mechanics.	III	Apply
CO3	Analyze the flow patterns and differentiate between the flow regimes and its effects.	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Basic equations of flow** Kinematics of flow, Control volume approach, Continuity equation, Momentum equation Linear momentum equation and angular momentum equation, Energy equation, Bernoulli equation	7
II	**Theory of Potential Flow and Hydrodynamic Stability** Kelvin's theorem, Stream function and Velocity potential, Irrational flow, Laplace equation and various flow fields, Combined flows and super	7

	positions, Examples of transition, Theoretical determination of CriticalReynolds Number, Stability of Elementary Flow fields, Rayleigh's Theorem, Flow in parallel channels, Stability of Boundary Layers, Numerical solution for Orr-Somerfield number.	
III	**Flow over immersed bodies and boundary layer flow** Boundary layer equations, flow over flat plate, Boundary layers with non-zero pressure gradient, Approximate methods for boundary layer equations, separation and vortex shedding.	7
IV	**Turbulent flow** Characteristics of Turbulent flow, Laminar turbulent transition, Governing equations for turbulent flow, Turbulent boundary layer equations, measurement of turbulent quantities, shear stress models, universal velocitydistribution and friction factor, fully developed turbulent flow, Dynamics ofturbulence	7
V	**Turbo machinery** Equations of turbomachinery, Axial flow turbines, compressors, pumps andfans, Radial flow turbines, compressors, pumps and fans, Power absorbing vs. power producing devices, Performance characteristics of centrifugal pumps, Performance characteristics of hydraulic turbines	6
VI	**Compressible Fluid Flow** One dimensional compressible fluid flow – flow through variable area passage – nozzles and diffusers, effect of viscous friction and heat transfer,fundamentals of supersonics flow normal and oblique shock waves and calculation of flow and fluid properties over solid bodies (like flat plate, wedge, diamond) using gas tables	6

Text Books	
1	Muralidhar and Biswas, Advanced Engineering Fluid Mechanics, , Alpha Science International, 2005
2	Irwin Shames, Mechanics of Fluids, , McGraw Hill, 2003

References	
1	Fox R.W., McDonald A.T , *Introduction to Fluid Mechanics*, John Wiley and Sons Inc,1985
2	Pijush K. Kundu, Ira M Kohen and David R. Dawaling, Fluid Mechanics, Fifth Edition, 2005

Useful Links	
1	https://youtu.be/H38vI93exns
2	https://youtu.be/DevReEKIYw8
3	https://youtu.be/IaqRi9qcNJI
4	https://youtu.be/lneVkFukEKk

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		2	2	2	
CO2		2				2
CO3				1	2	1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*	
AY 2022-23	
Course Information	
Programme	M.Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP551
Course Name	Research Methodology for Heat Power Engineers
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Interaction	2 Hrs/week	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 2			

Course Objectives	
1	To prepare the students to identify and formulate the research problems
2	To impart the Knowledge of planning and execution of research project, IPRs, Patents etc
3	To develop the student to prepare and write papers for publications to Conferences and Journals

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Classify the research problem and research plan.	II	Apply
CO2	Analyze the research problem, literature and methodology.	III	Analyze
CO3	Interpret the research papers, reports, case studies, patent information and database, etc	IV	Evaluate

Module	**Module Contents**	**Hours**
I	Meaning of research problem, Sources of research problem,Criteria, Characteristics of a good research problem, and Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problems, data collection, analysis, interpretation, Necessary Instrumentations.	5
II	Effective literature studies approaches, analysis. Plagiarism, Research ethics.	4
III	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.	5
IV	International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	4
V	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent Information and databases. Geographical Indications.	4
VI	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs	4

Text Books

1	C. R. Kothari, "Research Methodology", New Age international, 2nd edition, 2004.
2	Deepak Chopra and NeenaSondhi, "Research Methodology: Concepts and cases", Vikas Publishing House, New Delhi, 1998
3	Stuart Melville and Wayne Goddard, "Research Methodology: An Introduction for Science & Engineering Students", Tata MacGraw Hill, 2000
References	
1	E. Philip and Derek Pugh, "How to get a Ph. D. – a handbook for students and their supervisors, open university press, 2001.
2	Kumar R., "Research Methodology- A step by step guide for beginners", SAGE, 3rd Edition, 2012.
3	G. Ramamurthy, "Research Methodology", Dream Tech Press, New Delhi, 2009
Useful Links	
1	https://youtu.be/fLmzf4GpfvM
2	https://youtu.be/LmMDIBENHhU
3	https://youtu.be/0YBZci0rCGc
4	https://nptel.ac.in/courses/127/105/127105008/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		1			
CO2					2	2
CO3				2		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP545
Course Name	Heat Power Engineering Lab 1
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the mini, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Solve field problems by using different techniques in mechanical heat power engineering.	III	Applying
CO2	Analyse and present a detailed technical data/report based on mini project/experimentation work.	IV	Analysing
CO3	Design and develop suitable mechanical systems.	V	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):
Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of advanced fluid dynamics, Thermodynamics and combustion etc.

Textbooks	
1	Suitable books based on the contents of the mini project/experiments selected.

References	
1	Suitable books based on the contents of the mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per respective task

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2022-23						
Course Information						
Programme		M. Tech. (Mechanical Heat and Power Engineering)				
Class, Semester		First Year M. Tech., Sem I				
Course Code		6HP511				
Course Name		Computational Methods in fluid flow and heat transfer				
Desired Requisites:		Fluid Mechanics, Thermodynamics, Mathematics, Heat Transfer, Numerical methods				
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**	
Tutorial	-	30	20	50	100	
		Credits: 3				

Course Objectives	
1	Enable the students to analyse and solve fluid related problems by applying principles of mathematics, science and engineering.
2	Prepare students to use modern tools, techniques and skills to fulfill industrial needs related to computational techniques in fluid flow and heat transfer.
3	Train students with effective communication skill to demonstrate computational theories.
4	Develop skills in the analysis of fluid systems with mathematical modeling for applications of computers in research or design.
5	Develop a professional approach to lifelong learning in the numerical analysis to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level			
At the end of the course, the students will be able to,			
CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain prediction methods, PDEs and numerical methods.	II	Apply
CO2	Apply the FDM and FVM techniques to solve Fluid and Thermal related problems.	III	Analyze
CO3	Analyse boundary conditions, solution methods and schemes used in fluid flowand heat transfer problems.	IV	Evaluate

Module	**Module Contents**	**Hours**
I	**Comparison of experimental, theoretical and numerical approaches** Partial differential equations - Physical and mathematical classification -Parabolic, Elliptical and Hyperbolic equations. Computational economy, Numerical stability, Selection of numerical methods, validation of numerical results: Numerical error and accuracy – Round off error, accuracy of numerical results – Iterative convergence – Condition for convergence, Rate of convergence, under-relaxation and over relaxation, Termination of iteration: Tridiagonal Matrixalgorithm.	7

II	**Finite Difference method:** Discretization – Converting Derivatives to discrete Algebraic Expressions, Taylor's series approach, polynomial fitting approach, Discretization error.	6
III	**Heat conduction** Steady one-dimensional conduction in Cartesian and cylindrical co-ordinates, handling of boundary conditions: Two dimensional steady state conduction problems in Cartesian and cylindrical co-ordinates – point by point and line by line method of Solution: Dealing of Dirichlet, Neumann and Robbins type boundary conditions- Formation of discretized equations for regular boundaries, irregular boundaries and interfaces	7
IV	**One dimensional, two dimensional and three dimensional transient heat conduction problems in Cartesian and cylindrical co-ordinates** Explicit, Implicit, Crank Nicholson and ADI methods- stability of each system Conservation form and conservative property of partial differential equations and finite difference equations-Consistency, stability and convergence for marching problems Discrete perturbation stability analysis- Fourier or Von Neumann stability analysis.	7
V	**Finite volume method 1** Discretization of governing equations - Diffusion and convection-diffusion problems steady one-dimensional convection and diffusion, upwind, hybrid and power-law schemes:	6
VI	**Finite volume method 2** Discretization equation for two-dimensions: False diffusion, calculation for the Flow Field- Stream function- vortices approach, SIMPLE, SIMPLER, SIMPLEC and QUICK Algorithms. Numerical Marching Techniques. Two dimensional parabolic flows with heat; Grid generation methods, Adaptive grids.	7

	Text Books
1	S.V. Patankar, "Numerical Fluid Flow & Heat transfer", Hemisphere Publishing Corp., 1980.
2	T. Sundernajan, K. Muralidhar, "Computational Fluid Flow and Heat Transfer", Narosa, 2ndedition, Reprint 2011
	References
1	H. K. Versteeg and W. Malalasekera, "An Introduction to Computational Fluid Dynamics",Longman Scientific and Technical, 1st edition, 1995.
2	Hoffman Klaus, "Computational Fluid Dynamics", Vol-1 & 2, A Publication of EngineeringEducation System, Wichita Kansas, USA, 2000
	Useful Links
1	https://nptel.ac.in/courses/112/104/112104302/
2	https://nptel.ac.in/courses/112/108/112108091/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2			2	
CO2	2				2	
CO3	2			2		2

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP512
Course Name	Nuclear Engineering
Desired Requisites:	Heat and Mass Transfer

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Demonstrate the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down and absorption.
2	The student will also be familiar with concepts of reactor criticality, the relationship
3	The student will also be familiar with Time dependent (transient) behaviour of power reactor in nonsteady state operation and the means to control the reactor
4	The student will also be familiar with concepts of heat removal from reactor core, reactor safetyand radiation protection.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understanding the basic concepts and processes taking place inside a nuclear reactor	II	Apply
CO2	Analysing time dependent (transient) behaviour of power reactor in nonsteady stateoperation and the means to control the reactor	III	Analyze
CO3	Demonstrating concepts of heat removal from reactor core, reactor safety andradiation protection.	IV	Evaluate

Module	**Module Contents**	**Hours**
I	**Basics of nuclear fission and power from fission** Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding	6
II	**Neutron transport and diffusion** Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down	6
III	**Multigrain, multiregional diffusion equation, concept of criticality** Solution of multigrain diffusion equations in one region and multiregional reactors, concept of criticality of thermal reactors	7
IV	**Reactor kinetics and control** Derivation of point kinetics equations, in hour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients	6

V	**Heat removal from reactor core** Solution of heat transfer equation in reactor core, temperature distribution, critical heat flux	7
VI	**Reactor safety, radiation protection** Reactor safety philosophy, defence in depth, units of radioactivity exposure, radiation protection standards	6

	Text Books
1	Introduction to Nuclear Engineering (3rd Edition) by John R. Lamarsh, Anthony J.Barrata, Prentice Hall, (2001)
	References
1	Introduction to Nuclear Reactor Theory, by John R. Lamarsh, Addison-Wesley, 1966)
2	Nuclear Reactor Analysis, by James J. Duderstadt and Lewis J. Hamilton, John Wiley(1976)
	Useful Links
1	https://nptel.ac.in/courses/112/103/112103243/
2	https://nptel.ac.in/courses/112/101/112101007/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1					
CO2		1	1			
CO3				1		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2022-23					
Course Information					
Programme		M. Tech. (Mechanical Heat and Power Engineering)			
Class, Semester		First Year M. Tech., Sem I			
Course Code		6HP513			
Course Name		Design of Thermal Turbo Systems			
Desired Requisites:		Fluid and turbo machinery			
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Recognize typical designs of turbo machines and Explain the working principles of turbomachines and apply it to various types of machines
2	Determine the velocity triangles in turbomachinery stages operating at design and off-design conditions.
3	Perform the preliminary design of turbomachines (Fans compressors) on a 1-D basis
4	Use design parameters for characterizing turbomachinery stages and determine the off-design behavior of turbines and compressors and relate it to changes in the velocity triangles • Explainand understand how the flow varies downstream of a turbomachinery blade row
5	Recognize relations between choices made early in the turbomachinery design process and the final components and operability
6	Explain the limits of safe operation of compressors

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Understand the basics of turbo systems, the energy transformation in them.	II	Apply
CO2	Apply the knowledge on design of centrifugal and axial turbo systems.	III	Analyze
CO3	Analyze the turbo systems at different operating conditions.	IV	Evaluate

Module	Module Contents	Hours
I	**Introduction to Turbomachines:** Turbines Pumps and Compressors Fans and Blowers Compressible FlowMachines Incompressible Flow Machines Turbine, Compressor and Fan Stages Extended Turbomachines Axial Stages Radial Stages Mixed Flow Stages Impulse Stages Reaction Stages Variable Reaction Stages Multistage Machines Stage Velocity Triangles Design Conditions Off-design Conditions Applications	6
II	**Fluid Dynamic Principles:** Equations of Motion (in Cartesian, Cylindrical and Natural Coordinate system) Further notes on Energy Equation, Isentropic Flow through Blade passages, High speed flows, Aerofoil Blades.	7

III	**Dimensional Analysis and Performance Parameters**: Units and Dimensions, Buckingham's Pi theorem, Principle of similarity, Incompressible flow machines, Compressible flow machines, Performance of Compressors, Fans and Blowers.	7
IV	**Compressor:** Axial and Centrifugal compressor, Elements of centrifugal compressor stage, stage velocity triangles, Enthalpy – Entropy diagram, Stage losses and Efficiency, Performance characteristics	7
V	**Axial Fans and Propellers:** Fan Applications, Axial fans, Fan stage parameters, types of Axial fan stages, Propellers, Performance of Axial Fans.	6
VI	**Centrifugal Fans and Blowers:** Centrifugal Fan stage parameters, Design Parameters, Losses, Fan Drives, Bearings and Noise, Dust Erosion of Fans	6

	Text Books
1	S M Yahya , " Turbines, Compressors and Fans, McGrawHill Publication
2	Shepherd, D.G., "Principles of Turbomachinery", Macmillan, 1969.
	References
1	Bruneck, Fans, Pergamom Press, 1973
2	Earl Logan, Jr., Handbook of Turbomachinery, Marcel Dekker Inc., 1992
3	Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990.
4	Gopalakrishnan .G and Prithvi Raj .D, "A Treatise on Turbomachines", Scifech Publications(India) Pvt. Ltd., 2002.
	Useful Links
1	https://nptel.ac.in/courses/112/105/112105206/
2	https://nptel.ac.in/courses/101/101/101101058/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2			1
CO2		1	2		3	
CO3			2	3		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP514
Course Name	Design of Hydro Turbo machines
Desired Requisites:	Turbo Machinery

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To enable the students to analyse and solve hydrodynamic machine related problems by applying principles of mathematics, science and engineering.
2	To prepare students to handle various strategic issues related to hydrodynamic machines suchas turbines, pumps etc.
3	To train students with effective communication skills to demonstrate hydrodynamic theories.
4	To develop skills in designing the hydrodynamic machine component. To develop a professional approach to lifelong learning in the hydrodynamic machine to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Describe: different types of hydrodynamic machines and its components.	I	Remember
CO2	Apply knowledge of mathematics, science, and engineering for the needsin hydrodynamic machine design.	II	Apply
CO3	Carry out analysis and interpret results.	III	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction to Hydrodynamic Machines** Classification of turbines and various forms of turbine runners, Impulse turbines; general theory of impulse machines; performance characteristics, Reaction turbines; general theory of reaction machines;performance characteristics, types; Francis and Kaplan turbines; theory of cavitation flows in hydrodynamic runners. Hydrodynamic pumps; classification of pumps and various forms of pump impellers; general theory of centrifugal pumps; performance characteristics	7
II	Design of centrifugal pumps, selection of speed, determination ofimpeller inlet and outlet dimensions, meridional geometry inlet and	7

	exit blade angles, blade geometry, mixed flow pumps, elementarypump, design of twisted blade, design of volute, vaned diffuser and return passage, suction spiral.	
III	Axial flow pumps, selection of speed, pump casing geometry hubdiameter, number of blades and cascade solidity, selection of blade geometry on different flow surfaces, diffuser design.	6
IV	Introduction to hydraulic turbine design, Type series and diameterseries, selection of type and diameter, Reaction turbine runner spaces, meridional velocity field, elementary turbines, Hydraulic design ofFrancis turbine, Choice of basic parameters, Inlet and Outlet edges of runner blade, blade profiles on flow surfaces, shape of blade duct-velocity diagrams on different flow surfaces, certain guide linesto finalize the runner design, Guide wheel, Vane geometry and torque on controlling mechanism, Discharge and circulation, spiral, speedring, draft tube.	8
V	Hydraulic design of axial turbine runners, characteristics of some aerofoils, meridional flow field, blade geometry on each flow surface, procedure to finalize the runner design.	7
VI	Hydraulic design of pelton wheel, number of nozzles and their diameter, runner diameter, number of buckets, positioning of buckets, bucket geometry and size,-needle regulator, deflector.	7

	Text Books
1	Nechleba M., “Hydraulic Turbine their Design and Equipments”, Constable & Co., 1957.
2	Lazarkieniz & Troskolanrkis, “Impeller Pumps”, Pergamon Press, 1st edition, 1965.
3	Robinson J.A., “Hydraulic Engineering”, Jaico Publishing House, Bombay, 2nd Edition, 1998
	References
1	Andre Kovats, “Design and Performance of Centrifugal & Axial flow pumps & Compressors”, Pergamon, 1st edition. 1964.
2	Stapanoff, A.J., “Centrifugal & Axial Flow Pumps”, John Wiely, Rev ed, 1993.
3	Editor Brown, J.G., “Hydroelectric Engineering Practice”, Vol-I & II, 1st, edition,1958.
	Useful Links
1	https://nptel.ac.in/courses/112/105/112105206/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1	1	1	2	1
CO2		2	1	3	3	2
CO3			2	3	2	2
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP515
Course Name	Air-Conditioning System Design
Desired Requisites:	Thermodynamics, Fluid Mechanics, Heat Transfer, Refrigeration and Air-Conditioning.

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To enable the students to analyze and solve air conditioning related problems by applying principles of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfil industrial needs related to low temperature systems.
3	To train students with effective communication skills to demonstrate air conditioning theories.
4	To develop skills in the analysis of air conditioning systems in research or design.
5	To develop a professional approach to lifelong learning in the air conditioning to include the awareness of social and environment issues associated with engineering practices

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge of mathematics, science and engineering for the needs inair-conditioning.	II	Apply
CO2	Analyze different Air-Conditioning systems and their characteristics.	III	Analyze
CO3	Evaluate the performance and interpret the report in the field ofAir-Conditioning.	IV	Evaluate

Module	**Module Contents**	**Hours**
I	**Psychrometry** Moist Air properties, use of Psychometric Chart, Various Psychometrics processes, Air Washer, Adiabatic Saturation. Fundamental properties of air and water vapour mixtures. - Definitions, equations and explanations, psychometric table and charts, Enthalpy deviation curve, psychometric processes and their analysis, SHF, effective surface temperature and bypass factor. Air quality required. Analysis of combination of processes psychometric system. Load Analysis: Inside design conditions, outside design conditions, sensible heat load and latent heat loads, heat gains from	7

	infiltration ventilation, solar radiation from walls, occupants and other sources. Heating load, Load estimation chart.	
II	**Summer and Winter Air Conditioning** Air conditioning processes-RSHF, summer Air conditioning, Winter Air conditioning, Applications with specified ventilation air quantity- Use of ERSHF , Application with low latent heat loads and high latent heat loads, performance and selection.	6
III	**Heating & Cooling Load Calculations** Introduction, Health & comfort criteria, thermal comfort, air quality, estimating heat loss & heat gain, design conditions, thermal transmission, infiltration & ventilation loads, components of cooling load, internal loads, solar load through transparent surfaces, opaque surfaces, problems. Selection of components and system performance.	7
IV	**Air Distribution** Flow through Ducts, Static & Dynamic Losses, Air outlets, Duct Design– Equal Friction Method, Duct Balancing, Indoor Air Quality, Thermal Insulation, Fans & Duct System Characteristics, Fan ArrangementVariable Air Volume systems, Air Handling Units and Fan Coil units.	6
V	**Air Handling Equipments** Fans, air conditioning apparatus, unitary equipment, accessory equipment, Classification – all air- system, air water system, heat recovery system, radiation panel system, heat pump , air washers. noise control.	6
VI	**Industrial Applications of A.C** Major uses of air conditioning of medium sized & large buildings, industrial air conditioning, residential air conditioning, air conditioning of vehicles, food storage & distribution, food processing, pharmaceutical,chemical & process industry, special applications of air conditioning.	7

Text Books

1	Manohar Prasad, “Refrigeration & Air Conditioning”, New Age Publishers.
2	Stoecker, “Refrigeration & Air Conditioning”, McGraw Hill, 1992.
3	Arora C.P., “Refrigeration & Air Conditioning”, Tata McGraw Hill, 1985.
4	“Refrigeration and air-conditioning”, ARI, Prentice Hall, New Delhi, 1993.
5	Stoecker, “Design of Thermal Systems”, McGraw Hill, 1992.

References

1	“Handbook of air-conditioning system design”, Carrier Incorporation, McGraw Hill Book Co., U.S.A, 1965.
2	ASHRAE Handbook.: HVAC Systems and Equipment, 1996.
3	Hainer R.W., “Control Systems for Heating, Ventilation and Air-Conditioning”, Van Nostrand
4	Norman C. Harris, “Modern Air Conditioning”, New York, McGraw-Hill,1974.

5	Jones W.P., “Air Conditioning Engineering”, Edward Arnold Publishers Ltd., London,1984.

Useful Links	
1	https://youtu.be/e2IryaMQQ6A
2	https://youtu.be/YUgN5D-bmpg
3	https://youtu.be/Dj8ATzgrxyA
4	https://youtu.be/nvUhiXD63Eg

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	3	4	5	6
CO2			3			
CO3			2	2		
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP516
Course Name	Gas Turbines
Desired Requisites:	Thermodynamics, Fluid Mechanics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To enable the students to analyze and solve gas turbine related problems by applying principles of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needs related to gas turbine systems.
3	To train students with effective communication skills to demonstrate gas turbine theories.
4	To develop skills in the analysis of gas turbine systems in research or design.
5	To develop a professional approach to lifelong learning in the gas turbine to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge of mathematics, science, and engineering for designing gasturbine systems.	II	Apply
CO2	Analyse different gas turbine systems and their characteristics	III	Analyze
CO3	Evaluate the performance of gas turbine systems.	IV	Evaluate

Module	**Module Contents**	**Hours**
I	**Gas Turbine Plant:** Historical review. Thermodynamic analysis of practical gas turbine cycles. The turboprop engine. The compressor, combustor, turbine and exhaust nozzle characteristics. Performance characteristics of the stationary and turboprop and turbojet engine. The turbojet engine components. Specific thrust and overall efficiency. Static and flight performance at the design point. Fundamentals of rotating machines. Impulse and reaction machines. The centrifugal compressor: Works done and pressure rise. Design of centrifugal compressor, surge & stall.	7
II	**Axial Flow Compressor:**	6

	Principle of operation, velocity triangles. Design procedure for single and multistage compressors. Three dimensional effect compressor performance. Description and problems of transonic and supersonic compressors.	
IV	**Combustion in Gas Turbine:** Problem to be faced in the design of gas turbine combustion systems. Fuel injection system. Combustion chamber designs. Pressure loss. Temperature distribution, Reaction time, Flame stabilization.	7
V	**Turbine Characteristics:** Off design performance of gas turbine plant, matching of the engine components, equilibrium running diagram. Specific thrust and specific fuel consumption in such cases for stationary turbojet and turboprop units.	7
VI	Materials used in Gas Turbine system, Environmental Considerations and Applications, Failure analysis.	5
Text Books		
1	V. Ganesan "Gas Turbine" Tata McGraw-Hill Education, 2ndedi. ,2003	
References		
1	Cohan, Rogers "Gas Turbine" Person, 5th edition. ,2001	
2	Dr.Meherwan P. Boyce, P.E "Gas Turbine Engineering" Handbook, 3rd edition, 2011.	
3	Earl Logan "Handbook of Turbomachinery" CRC press, 2003.	
Useful Links		
1	https://nptel.ac.in/courses/112/103/112103262/	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2				2	
CO2	2			2	2	
CO3	2					2
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP546
Course Name	Heat Power Engineering Lab 3
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the mini, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Solve field problems by using different techniques in mechanical heat power engineering.	III	Applying
CO2	Analyse and present a detailed technical data/report based on mini project/experimentation work.	IV	Analysing
CO3	Design and develop suitable mechanical systems.	V	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of computational methods, Thermal and Hydro system, Air Conditioning system, Gas Turbines, Nuclear Engineering etc.

The student will select the thrust area depending upon his/her professional elective 1 and 2

Textbooks	
1	Suitable books based on the contents of the mini project/experiments selected.

References	
1	Suitable books based on the contents of the mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per respective task

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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Course Information					
Programme		M. Tech. (Mechanical Heat and Power Engineering)			
Class, Semester		First Year M. Tech., Sem II			
Course Code		6HP521			
Course Name		Advanced Heat Transfer			
Desired Requisites:		Basic heat transfer			
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To provide the student with general techniques to formulate, model and mathematicallysolve advanced heat transfer problems;
2	To provide the student with a detailed, but not exhaustive, presentation of selectedadvanced topics in convective heat transfer that are representative of "real world" engineering problems;
3	To introduce basic numerical methods and software tools for solving heat transferproblems.
4	To use appropriate analytical and computational tools to investigate heat and masstransport Phenomena.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Understand the physical modelling aspects of heat transfer and an ability to make the appropriate choice between exact and approximate calculations in solving problems of heat transfer in complex systems.	I	Understand
CO2	Identify the analogy of flow and momentum diffusion to heat and mass transfer and identify the interdisciplinary character of real-life thermal engineering.	II	Remember
CO3	Analyse heat transfer in complex internal flow systems and in boundarylayers and external flow configurations	III	Analyzing

Module	**Module Contents**	**Hours**
I	Conduction- One and Two Dimensions.	7
II	Fins, conduction with heat source, unsteady state heat transfer.	6
III	Natural and forced convection, integral equation, analysis andanalogies.	6
IV	Transpiration cooling, ablation heat transfer, boiling, condensationand two phase flow mass transfer, cooling, fluidized bed combustion.	6
V	Heat pipes, Radiation, shape factor, analogy, shields.	7

VI	Radiation of gases, vapors and flames, Network method of analysisfor Radiation Problem.	7

Text Books	
1	S. P. Sukhatme, " A TextBook on Heat Transfer", Universities Press, 4thEdition,2006.
2	Yunus. A. Cengel, "Heat Transfer – A Practical Approach", Tata McGraw Hill, 3rdEdition, 2006.
3	Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", Wileypublications, 2nd Edition, 2007.
4	P. K Nag, " Heat and Mass transfer", Tata McGraw Hill, 2nd Edition.
References	
1	Eckert and Drabe, "Analysis of Heat and Mass Transfer", McGraw Hill HigherEducation, 2003.
2	H. Schlichting , K. Gersten, " Boundary Layer Theory" Springer, 8th edition, 2000.
3	J. P. Holman, " Heat Transfer", McGraw Hill Book Company, New York, 1990.
4	Frank Kreith,"Principles of Heat Transfer", Harper and Row Publishers, New York, 1973.
5	Donald Q. Kern, " Process Heat Transfer", Tata McGraw Hill Publishing CompanyLtd., New Delhi, 1975.
6	R. C. Sachdeva,"Fundamentals of Engineering Heat and Mass Transfer", WileyEastern Ltd., India.
7	Latif M. Jiji, "Heat Conduction", Springer, 3rd edition, 2009.
Useful Links	
1	https://nptel.ac.in/courses/112/101/112101001/
2	https://nptel.ac.in/courses/112/105/112105271/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		1			
CO2		2		2		
CO3		1				

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP522
Course Name	Steam Engineering
Desired Requisites:	Basic heat transfer

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To analyze different types of steam cycles and estimate efficiencies in a steam powerplant.
2	To design pipe insulation through proper selection of materials with the help of basic heattransfer theory.
3	To access boiler performance for different loading conditions.
4	To develop a professional approach for lifelong learning in steam engineering to includethe awareness of social and environmental issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain working of different boilers and significance of mountings and accessories. and to use techniques, skills, and modern engineering tools necessary for boiler performance assessment	I	Remembering
CO2	Design a steam piping system, its components for a process and also design economical and effective insulation. And to analyse a thermal system for sources of waste heat design a systems for waste heat recovery	II	Applying
CO3	Design and develop controls and instrumentation for effective monitoringof the process	III	Analyzing

Module	**Module Contents**	**Hours**
I	Introduction Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers, Types, Mountings and Accessories, Combustion inboilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards.	7

II	Piping & Insulation Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.	8
III	Steam Systems Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipment's Systems.	8
IV	Boiler Performance Assessment Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boilerperformance.	8
V	Energy Conservation and Waste Minimization Energy conservation options in Boiler; waste minimization, methodology; economic viability of waste minimization.	5
VI	Instrumentation & Control Process instrumentation; control and monitoring. Flow, pressure andtemperature measuring and controlling instruments, its selection.	6

Text Books	
1	T. D. Estop, A. McConkey, Applied Thermodynamics, Parson Publication.
2	Domkundwar; A Course in Power Plant Engineering; Dhanapat Rai and Sons.
3	Yunus A. Cengel and Boles, "Engineering Thermodynamics ", Tata McGraw-Hill Publishing Co. Ltd.
References	
1	Energy Performance Assessment for Equipment & Utility Systems; Bureau of Energy Efficiency.
2	P. Chatopadhyay; Boiler Operation Engineering: Questions and Answers; Tata McGrawHill Education Pvt Ltd, N Delhi
3	Edited by J. B. Kitto& S C Stultz; Steam: Its Generation and Use; The Babcock and Wilcox Company.
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107216/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1	2	1	2	1
CO2	1	1	1	3	2	2
CO3	1	1	2	3	3	2

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be

field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23	
Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6HP571
Course Name	Heat Power Engineering Lab 3
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the mini, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Solve field problems by using different techniques in mechanical heat power engineering.	III	Applying
CO2	Analyse and present a detailed technical data/report based on mini project/experimentation work.	IV	Analysing
CO3	Design and develop suitable mechanical systems.	V	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Advanced heat transfer, Steam Engineering etc.

Textbooks	
1	Suitable books based on the contents of the mini project/experiments selected.

References	
1	Suitable books based on the contents of the mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per respective task

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

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Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP591
Course Name	Pre-dissertation Work and Seminar
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives

1	To Review and increase students' understanding of the specific topics.
2	To induce Learning management of values.
3	To teach how research papers are written and read such papers critically and efficiently and to summarize and review them to gain an understanding of a new field, in the absence of a textbook.
4	To teach how to judge the value of different contributions and identify promising new directions in specified area.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the existing knowledge on real life problems	III	Applying
CO2	Investigate the selected topic/ system.	IV	Analysing
CO3	Verify the outcomes of the work have solved the specified problems.	V	Evaluating

List of Experiments / Lab Activities/Topics

Contents:

The pre-dissertation work will start in semester II and should preferably be a problem with research potential and should involve scientific research review, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based preferably on the area in which the candidate is interested to undertake the dissertation work. The candidate has to be in regular contact with their guide and the topic of seminar/dissertation must be mutually decided. The examination shall consist of the preparation of report consisting literature review, detailed problem statement, case studies, etc, according to type of work carried out. The work has to be presented in front of the examiners panel formed by DPGC for evaluation.

Textbooks

1	Suitable books based on the contents of the dissertation/seminar topic selected.

References

1	Suitable books based on the contents of the dissertation/seminar topic selected and research papers from reputed national and international journals and conferences.

Useful Links

1	As per the need of the dissertation/seminar topic.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	1			
CO2	3				1	
CO3		3			2	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP523
Course Name	Internal Combustion Engine Design
Desired Requisites:	Thermodynamics, Heat Transfer

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To enable the students to analyze and solve I.C.Engine related problems by applying principles of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needs related I.C.Engine systems.
3	To train students with effective communication skill to demonstrate I.C.Engine theories.
4	To develop skills in the analysis of I.C.Engine systems in research or design.
5	To develop a professional approach to lifelong learning in the I.C.Engine to include the awareness of social and environment issues associated with engineering practices

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the knowledge of mathematics, science, and engineering for the needsin I.C. Engine.	III	Applying
CO2	Analyse the I C engine systems and its design report	IV	Analyzing
CO3	Evaluate performance of I.C. Engines under different conditions andinterpret the reports.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Engine Design:** Engine selection, basic data for design like power torque, speed, mean effective pressure, air consumption, fuel consumption, stroke to bore ratio, heat distribution, exhaust temperature, power to weight ratio,	5
II	**Design Considerations:** Combustion chamber design considerations for S.I. and C.I. engines. Thermal and Mechanical design of cylinder, piston, piston rings, cylinder head, valves, Mechanical design of connecting rod, crankshaft and crank case.	5

III	**Simulation of I.C. Engine Processes** Simulation, S.I. Engine simulation with air as working medium,simulation with adiabatic combustion. Definitions of progressive combustion model, gas exchange process model and heat transferprocess model	5
IV	**Carburetion and Injection:** Carburetion Mixture characteristics ,distribution, Carburetor systems,Carburetor and stratified charge engines, S.I. Engine fuel injection system and type, Modern Carburetor designs and air Pollution control, altitude compensation. **Injection Systems:** Design, Bosch distribution pump, Cummins- P-T injection system, Spray characteristics ,quantity of fuel per cycle, types of nozzles, injection timing, fuel line hydraulics,	4
V	**Cooling System:** Design, Heat transfer in I.C. engines, piston and cylinder temperatures, heat rejected to coolant, comparison of air and water cooling, temperature distribution for air and water cooled engine across the cylinder wall, **Ignition System:** Requirements, battery ignition, magneto ignition and electronic ignition systems, centrifugal and vacuum advance; spark plug types and selection, firing order and its importance.	4
VI	**Other Engine Designs** **Wankel Engine:** Working principle, engine geometry, engine scaling, lubrication, cooling, induction, ignition systems, combustion in rotary engine, performance, advantages and applications	3

	Text Books
1	J. B. Heywood I. C Engine Fundamentals", Tata McGraw Hill Pub.1st edition 1998.
2	V. Ganesan, 'Internal Combustion Engines', Tata McGraw Hill Book Co, EighthReprint, 2005.
	References
1	F. Obert, "Internal Combustion Engines and Air Pollution", In-text EducationalPublishers, 1st edition 1973.
2	Colin Fergusson, Allan Kirkpatrick, "Internal Combustion Engines" Wiley Publication.
3	P. M. Heldt, "High Speed Combustion Engines", Chilton company 4th edition 1956.
	Useful Links
1	https://nptel.ac.in/courses/107/106/107106088/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1					2	
CO2		2		3		
CO3	1		2			2

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP524
Course Name	Design of Heat Exchangers
Desired Requisites:	Fundamentals of heat transfer and fluid mechanics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Enable the students to analyze and solve heat exchanger problems by applying principles of mathematics, science and engineering.
2	Prepare students to use modern tools, techniques and skills to fulfill industrial needs related to design of heat exchanger.
3	Train students with effective communication skills to demonstrate heat exchanger theories.
4	Develop skills in the analysis of heat exchanger with mathematical modeling for applications in research or design.
5	Develop a professional approach to lifelong learning in the heat exchangers to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply fundamental knowledge of mathematics, science, and engineering forthe needs in heat exchanger designing.	III	Applying
CO2	Thermal and Hydraulic design of different types of heat exchangers	IV	Analyzing
CO3	Mechanical Design of Heat Exchangers	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Types of heat exchanger Hrs.** Heat Exchangers – Classification according to transfer process, numberof fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.	4

II	**Heat exchanger design methodology Hrs.** Assumption for heat transfer analysis, problem formulation, e-NTUmethod, *P*-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.	4
III	**Compact** and **Double Pipe Heat Exchangers Hrs.** Thermal and Hydraulic design of compact heat exchanger. Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop.	5
IV	**Direct-contact heat exchanger, cooling towers Hrs.** Relation between the wet-bulb and dew point temperatures - The Lewis number –Classification of cooling towers cooling-tower internals and the role of fill – Heat exchange heat transfer by simultaneous diffusion and convection - Analysis of cooling towers measurements - Design of cooling towers - Determination of the number of diffusion units -	4
V	**Shell and Tube heat exchangers Hrs.** Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers	5
VI	**Mechanical Design of Heat Exchangers Hrs.** Design standards and codes, key terms in heat exchanger design, material selection, and thickness calculation for major components such as tube sheet, shell, tubes, flanges and nozzles.	4

Text Books	
1	Ramesh K. Shah and Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" John Wiley and sons Inc., 2003.
References	
1	D.C. Kern, "Process Heat Transfer", McGraw Hill, 1950.
2	SadikKakac and Hongton Liu, "Heat Exchangers: Selection, Rating and Thermal Design" CRC Press, 1998.
3	A .P. Frass and M.N. Ozisik, "Heat Exchanger Design", McGraw Hill, 1984
4	Afgan N. and Schlinder E.V. "Heat Exchanger Design and Theory Source Book".
5	T. Kuppan, "Hand Book of Heat Exchanger Design".
6	"T.E.M.A. Standard", New York, 1999.
7	G. Walkers, "Industrial Heat Exchangers-A Basic Guide", McGraw Hill, 1982.
Useful Links	
1	https://nptel.ac.in/courses/112/105/112105248/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**

CO1	3					
CO2	3	2				2
CO3	3		2	2		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
AY 2022-23						
Course Information						
Programme		M. Tech. (Mechanical Heat and Power Engineering)				
Class, Semester		First Year M. Tech., Sem II				
Course Code		6HP525				
Course Name		Industrial Refrigeration				
Desired Requisites:		Thermodynamics, Heat Transfer				
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**	
Tutorial	-	30	20	50	100	
		Credits: 3				

Course Objectives	
1	To enable the students to analyse and solve refrigeration related problems by applying principles of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needs related to refrigeration systems.
3	To train students with effective communication skill to demonstrate refrigeration/theories.
4	To develop skills in the analysis of refrigeration systems in research or design.
5	To develop a professional approach to lifelong learning in the refrigeration/ to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes (CO) with Bloom's Taxonomy Level			
At the end of the course, the students will be able to			
CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge of mathematics, science, and engineering for the needs inRefrigeration	III	Applying
CO2	Analyse different Refrigeration systems and their characteristics	IV	Analyzing
CO3	Evaluate the performance of different refrigeration systems	V	Evaluating

Module	**Module Contents**	**Hours**
I	Industrial refrigeration as distinguished from comfort air-conditioning, What is industrial refrigeration, Refrigerated storage of unfrozen food, Frozen food, Refrigeration in food processing, freeze drying	4

II	Carnot cycle , conditions for high cop of Carnot cycle ,Steady flowenergy equation, Analysis of Carnot cycle using refrigerant enthalpies, Dry vs wet compression, The standard vapour compression cycle	4
III	Reciprocating, scroll and screw compressor: Multistage industrial applications, cylinder arrangement, cooling methods - oil injection	4

IV	Types of Evaporators, Liquid circulation: Mechanical pumping and gas pumping - advantage and disadvantage of liquid re-circulation -circulation ratio - top feed and bottom feed refrigerant - Net Positive Suction Head (NPSH) - two pumping vessel system - suction risers – design - piping loses. Different Industrial Condensers arrangement	5
V	Vessels in industrial refrigeration: High pressure receiver - flash tank - liquid and vapor separator - separation enhancers - low pressure receivers - surge drum	4
VI	Conservation and design considerations - source of losses - critical thickness – insulation cost and energy cost - vapor barriers – construction methods of refrigerated spaces.	5
Text Books		
1	C. P. Arora ,"Refrigeration and Air conditioning", Tata Mcgraw Hill EducationPrivate Limited , third edition,2008.	
2	Wilbert F. Stoecker, Industrial refrigeration handbook, Mcgraw-hill Professional Publishing 1st edition., ,1998	
References		
1	Roy J. Dossat "Principals of Refrigeration", Pearson, 4th edition, 2007	
2	ASHRAE1998. Hand Book: Refrigeration,	
3	ASHRAE Hand Book: HVAC Systems and Equipment, 1996. Journal of Air conditioning and refrigeration- ISHRAE, ASHRAE.	
Useful Links		
https://nptel.ac.in/courses/112/105/112105129/		

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1			1		
CO2	2		2	2		
CO3			1	2		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP526
Course Name	Cryogenics
Desired Requisites:	Refrigeration and Air Conditioning

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To enable the students to analyze and solve cryogenics related problems by applying principles of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needs related to low temperature systems.
3	To train students with effective communication skills to demonstrate cryogenics theories.
4	To develop skills in the analysis of cryogenics systems in research or design.
5	To develop a professional approach to lifelong learning in the refrigeration/air conditioning/cryogenics to include the awareness of social and environment issues associated with engineering practices

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge of mathematics, science, and engineering for the needs inCryogenic.	III	Applying
CO2	Analyze different Cryogenic systems.	IV	Analyzing
CO3	Evaluate and interpret the analysis reports in the field of Cryogenic	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Cryogenic fluids and applications** Introduction, properties of cryogenic fluids, properties of materials used in cryogenics at lower temperature, superconductive materials, applications of cryogenics	4
II	**Gas Liquefaction** Gas liquefaction & refrigeration systems, Basics of refrigeration & liquefaction, ideal thermodynamic cycle, Joule Thomson effect, adiabatic expansion, various liquefaction cycles, Liquefaction systems for air, Neon, Hydrogen & Helium gas	5

III	**Gas Separation and Purification** Gas separation and purification – principles, Gas separation systemsfor air, hydrogen	5
IV	**Cryocoolers** Cryogenic refrigeration systems, Ideal and practical systems, Joule-Thompson cryocoolers, Stirling Cycle Refrigerators,	4
V	**Cryogenic fluid storage and transfer systems** Cryogenic Dewar, Cryogenic Transfer Lines, Two phase flow incryogenic transfer system	4
VI	**Instrumentation and safety** Instrumentation in cryogenics to measure Flow, Level and Temperature	4

Text Books	
1	Barron. R.F. Cryogenic Systems, McGraw-Hill, 2nd edition 1985.
References	
1	Thomas M. Flynn, “Cryogenic Engineering”, Marcel Dekker. Inc New York illustrated edition 1997.
2	Marshall Sittig, D. Van Nostrand Co. “Cryogenics - Research and Applications”, Princeton N.J, Van Nostrand . 1963Scott, R. B, Cryogenic Engineering, Scott, R. B. D’Van-Nostrand, 1962.
3	Vance, R. W., Applied Cryogenic Engineering, , John Wiley and sons, 1st edition 1962.
4	M. Sitting , “Cryogenic”, D’ Van-Nostrand company, 1st edition 1963.
Useful Links	
1	https://nptel.ac.in/courses/112/101/112101004/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1					1	
CO2	2	2	2	2		
CO3	2					1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP527
Course Name	Modelling of Internal Combustion Engines
Desired Requisites:	Mathematics, Thermodynamics, Heat Transfer

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	Students will demonstrate a basic understanding of several types of engine models that will include zero dimensional thermodynamic model, one dimensional and multidimensional, single zone, two zone etc models.
2	Students will develop models and simulate them for diesel engine petrol engine, gas engine**.**
3	Students will demonstrate the performance evaluation and emission standards for such modelled engines

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge of basic I C Engine to model SI and CI Engine	III	Applying
CO2	Analyze the different Engine processes	IV	Analyzing
CO3	Evaluate the Engine cycle parameters for different conditions	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Fundamentals:** Governing equations, Equilibrium charts of combustion chemistry, chemical reaction rates, and approaches of modeling, model building and integration methods	5
II	**Thermodynamic Combustion Models of CI Engines:** Single zone models, premixed and diffusive combustion models, combustion heat release using wiebe function, wall heat transfer correlations, ignition delay	5
III	**Fuel spray behavior:** Fuel injection, spray structure, fuel atomization, droplet turbulence interactions	5
IV	**Modeling of charging system:** Constant pressure and pulse turbo charging, compressor and turbine maps	5

V	**Mathematical models of SI Engines**: Simulation of Otto cycle at full throttle, part throttle and supercharged conditions. Progressive combustion, Auto ignition modeling, single zone models, mass burning rate estimation, SI Engine with stratified charge. Friction in pumping, piston assembly, bearings and valve train etc. friction estimation forwarm and warm up engines.	6

Text Books	
1	J.B.Heywood, 'Internal Combustion Engine Fundamentals', McGraw Hill Book Co, 1988
2	V. Ganesan, 'Internal Combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
References	
1	Heywood, "I.C. Engines", McGraw Hill.
2	Ramos J (1989**), "**Internal Combustion Engine Modeling**",**Hemisphere Publishing Company
3	C. D. Rakopoulos and E. G. Giakoumis, "Diesel Engine Transient Operation".
4	Operation Principles of Operation and Simulation Analysis", Springer, 2009.
5	V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill, New Delhi, 1996.
6	P.A. Lakshminarayanan and Y. V. Aghav, " Modelling Diesel Combustion" Springer, 2010
7	Bernard Challen and RodicaBaranescu,"Diesel Engine Reference Book" Butterworth Heinemann, 1999.
Useful Links	
1	https://nptel.ac.in/courses/112/104/112104272/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1				3	
CO2		2		3		
CO3		1			2	2

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information					
Programme		M. Tech. (Mechanical Heat and Power Engineering)			
Class, Semester		First Year M. Tech., Sem II			
Course Code		6HP528			
Course Name		Industrial Air-Conditioning			
Desired Requisites:		Refrigeration and Air-Conditioning.			
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To enable the students to analyse and solve air conditioning related problems by applying principles of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfil industrial needsrelated to air conditioning.
3	To train students with effective communication skills to demonstrate air conditioning theories.
4	To develop skills in the analysis of air conditioning systems in research or design.
5	To develop a professional approach to lifelong learning in the air conditioning to includethe awareness of social and environment issues associated with engineering practices

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Apply knowledge of mathematics, science and engineering for the needs inair-conditioning.	III	Applying
CO2	Analyse different Air-Conditioning systems and their characteristics.	IV	Analyzing
CO3	Evaluate the performance and interpret the report in the field ofAir-Conditioning.	V	Evaluating

Module	Module Contents	Hours
I	Psychrometry: moist air properties; mass transfer and evaporation of water into moist air; theory of psychrometer; correlation of w.b.t. with temperature of adiabatic saturation; Lewis number; construction of psychrometric chart.	5
II	Heat and Mass Transfer: Direct contact transfer equipment; simple air washer and indirect evaporative cooling contact mixture principle; enthalpy potential; basic equation for direct contact transfer equipment; graphical and analytical methods for heat and mass transfer analysis of air washers with heated and chilled water sprays	4

III	Ventilation: Necessity; ventilation standards; natural and mechanical ventilation; forces for natural ventilation; general ventilation rules; determining ventilation requirement; use of decay equation.	4
IV	Air Cleaning: Physical and chemical vitiation of air; permissible concentration of air contaminants; mechanical and electronic air cleaners; dry and wet filters; radiators and convectors. Design of a year-round air conditioning system.	4
V	Air handling Equipment: Fans & Duct System Characteristics, Fan Arrangement Variable Air Volume systems, Air Handling Units and Fan Coil units. air conditioning apparatus, unitary equipment, accessory equipment, Noise control. Piping and Ducts: Pressure drops in piping and fittings; design of water and refrigerant piping; Air conditioning duct design methods.	5
VI	Industrial Applications: Major uses of air conditioning for medium sized & large industrial buildings. Application of air conditioning in Pharmaceutical, textile industry.	4

Text Books	
1	Manohar Prasad, "Refrigeration & Air Conditioning", New Age Publishers.
2	Stoecker, "Refrigeration & Air Conditioning", McGraw Hill, 1992.
3	Arora C.P., "Refrigeration & Air Conditioning", Tata McGraw Hill, 1985.
4	"Refrigeration and air-conditioning", ARI, Prentice Hall, New Delhi, 1993.
References	
1	ASHRAE Handbook.: HVAC Systems and Equipment, 1996.
2	Hainer R.W., "Control Systems for Heating, Ventilation and Air-Conditioning", VanNostrand
3	Norman C. Harris, "Modern Air Conditioning", New York, McGraw-Hill,1974.
4	Jones W.P., "Air Conditioning Engineering", Edward Arnold Publishers Ltd.,London,1984.
5	Carrier Hand Book.
6	Roy J Dossat " Principles of Refrigeration.
Useful Links	
1	https://nptel.ac.in/courses/112/105/112105129/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1			3		
CO2	2		2	2		
CO3			1	1		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6HP572
Course Name	Heat Power Engineering Lab 4
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the mini, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Solve field problems by using different techniques in mechanical heat power engineering.	III	Applying
CO2	Analyse and present a detailed technical data/report based on mini project/experimentation work.	IV	Analysing
CO3	Design and develop suitable mechanical systems.	V	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of IC Engine design and modelling, Heat Exchanger, Industrial Refrigeration /Air Conditioning, Cryogenics etc.

The student will select the thrust area depending upon his/her professional elective 3 and 4

Textbooks	
1	Suitable books based on the contents of the mini project/experiments selected.

References	
1	Suitable books based on the contents of the mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per respective task

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				