Walchand College of Engineering

(Government Aided Autonomous Institute)

Vishrambag, Sangli-416415

1947

Course Content for F. Y. M. Tech. Mechanical (Heat Power Engineering)

Semester-I

2023-24

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Program	M. Tech. All Branches
Class, Semester	First Year M. Tech., Semester I
Course Code	7IC501
Course Name	Research Methodology and IPR

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

Course Objectives

1	To prepare students for undergoing research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.
2	To enable student interpret the results, propose theories, suggest possible/alternative solutions, solve, and prove the solution adapted–logically and analytically, conclude the research findings.
3	To impart knowledge to analyze critically the literature and publish research in conferences, journals and to expose students to research ethics, IPR and Patents

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Demonstrate** a research solution in respective engineering domain using appropriate Engineering research process and research methodology.	Apply
CO2	**Device** feasible solution to a research problem in respective engineering domain based on economic, social and legal aspects using appropriate research procedures and practices.	Analyze
CO3	**Write** research publication, Dissertation, IPR and patent document.	Create

Module	Module Contents	Hours
I	**Engineering Research Process** Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Definition, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	6
II	**Research Methodology** Problem statement formulation, resources identification for solution, Experimental and Analytical modelling, Simulations, Numerical and Statistical methods in engineering research. Hypothesis and its testing by different techniques: Z-test etc.,	6
III	**Research Methods** Uni and Multivariate Analysis: ANOVA, Design of Experiments/Taguchi Method, Regression Analysis. Software tools like spreadsheets. Processing and Analysis of Data: Processing Operations, Types of Analysis-Presentation and Interpretation of Data Editing, Classification and Tabulation-	7

Solapure 25-8-2023
Dr. S.S. Solapure
Associate Professor (IT) Dept.

Dr. R.S. Desai 23/8/2023
Applied Mechanics Dept.

	Interpretation. Analyse your results and draw conclusions.	
IV	**Research Practices** Effective literature studies approaches, critical analysis, Plagiarism, Research ethics, Mendeley - Reference Management Software. Research communication- Effective Technical Writing, Writing a research article for Journal/conference paper, Technical report, Dissertation/ Thesis report writing, Software used for report writing such as WORD, Latex etc. Presentation techniques for paper/report/seminar. Publishing article in Scopus/SCI/Web of science indexed journal or conference.	7
V	**Intellectual Property Rights (IPR)** Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Ownership of copyright, Term of copyright, Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. New developments in IPR, Traditional knowledge ,Various Case Studies.	7
VI	**Patents** Patent Rights: Scope of Patent Rights. Various Patent databases. Geographical Indications. Procedure for grants of patents, Patenting under PCT. Licensing and transfer of technology. Administration of Patent System. Introduction to International Scenario: WIPO, TRIPs, Patenting under PCT	6

	Textbooks
1	Kothari C. R, "Research Methodology", 2nd Edition, New Age International, 2004
2	Melville Stuart and Goddard Wayne, "Research Methodology: An Introduction for Science & Engineering Students" Juta and Company Ltd, 2000.
3	Kumar Ranjit, "Research Methodology: A Step-by-Step Guide for beginners", SAGE Publications, 4th Ed.-2014.
	References
1	Merges Robert, Menell Peter, Lemley Mark, "Intellectual Property in New Technological Age", ASPEN Publishers, 2016.
2	Ramappa T., "Intellectual Property Rights Under WTO", S. Chand, 2008
3	Mayall, "Industrial Design", McGraw Hill, 1992.
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
5	Deepak Chopra and Neena Sondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi
	Useful Links
1	NPTEL :: General - NOC:Introduction to Research
2	Introduction to Research - Course (nptel.ac.in)
3	Qualitative Research Methods And Research Writing - Course (nptel.ac.in)
4	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
5	https://www.scopus.com/search/form.uri?display=basic#basic
6	https://onlinecourses.nptel.ac.in/noc21_ge12/preview - Qualitative Research Methods And Research Writing
7	https://onlinecourses.nptel.ac.in/noc21_hs44/preview - Effective Writing
8	https://webofscienceacademy.clarivate.com/learn

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9	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
10	https://nptel.ac.in/courses/121/106/121106007/
11	https://www.wipo.int/about-wipo/en/

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

The strength of mapping is to be written as 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)

Solapur
28-8-2023
DE.S.S.Solapure
Associate Professor (IT)
Dept.

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP501
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 analyse 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	Explain 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	6
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 lawand 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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Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP502
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 needs related to fluid dynamics.
3	To train students with effective communication skill to demonstrate fluid dynamics theories.
4	To develop skills in the analysis of fluid systems with mathematical modeling for applications of fluid dynamics in research or design.
5	To develop a professional approach for lifelong learning in the fluid dynamics 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 and define the fluid flow problems along with range ofgoverning 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 andits 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 Critical Reynolds 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.	6
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 velocity distribution and friction factor, fully developed turbulent flow, Dynamics of turbulence	7
V	**Turbo machinery** Equations of turbomachinery, Axial flow turbines, compressors, pumps and fans, 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*, FifthEdition, 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)

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP503
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	Explain the physical modelling aspects of heat transfer and an ability to make the appropriate choice between exact and approximatecalculations in solving problems of heat transfer in complex systems.	II	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.	III	Apply
CO3	Analyse heat transfer in complex internal flow systems and in boundarylayers and external flow configurations	IV	Analyze

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.	7
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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AY 2023-24

Course Information

Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP551
Course Name	Thermodynamics and Combustion Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

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 experiment / mini-project, 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 in Thermodynamics and Combustion by using different techniques.	III	Apply
CO2	Verify the concepts related to Thermodynamics and Combustion.	IV	Analyse
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

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 Thermodynamics and Combustion.

Textbooks

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

References

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

Useful Links

1	As per the need of the experiment/mini project.

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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AY 2023-24

Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP552
Course Name	Advanced Fluid Dynamics Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

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 experiment / mini-project, 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 Advanced Fluid Dynamics.	III	Apply
CO2	Verify the concepts related to Advanced Fluid Dynamics.	IV	Analyse
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

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

Textbooks

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

References

1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed National and International Journals and Conferences.

Useful Links

1	As per the need of the experiment/mini project.

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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AY 2023-24

Course Information	
Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP553
Course Name	Advanced Heat Transfer Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

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 experiment / mini-project, 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 Advanced Heat Transfer.	III	Apply
CO2	Verify the concepts related to Advanced Heat Transfer.	IV	Analyse
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

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.

Textbooks

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

References

1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed National and International Journals and Conferences.

Useful Links

1	As per the need of the experiment/mini project.

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%				
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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. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP511
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 asnuclear 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	Apply the basic concepts and processes taking place inside a nuclear reactor		Apply
CO2	Analysing time dependent (transient) behaviour of power reactor in nonsteady stateoperation and the means to control the reactor		Analyze
CO3	Demonstrating concepts of heat removal from reactor core, reactor safety andradiation protection.		Evaluate

Module	**Module Contents**	**Hours**
I	**Basics of nuclear fission and power from fission** Radioactivity, nuclear reactions, cross sections, nuclear fission, power fromfission, 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	7
III	**Multigrain, multiregional diffusion equation, concept of criticality** Solution of multigrain diffusion equations in one region and multiregionalreactors, concept of criticality of thermal reactors	7
IV	**Reactor kinetics and control** Derivation of point kinetics equations, in hour equation, solutions for simplecases of reactivity additions, fission product poison, reactivity coefficients	7

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)

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AY 2023-24

Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP512
Course Name	Design of Thermo 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	Apply the basics of turbo systems, the energy transformation in them.	III	Apply
CO2	Design of centrifugal and axial turbo systems.	IV	Analyze
CO3	Evaluate performance of turbo systems.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to Turbomachines:** Turbines Pumps and Compressors Fans and Blowers Compressible Flow Machines 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	7
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	7

	speed flows, Aerofoil Blades.	
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)

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AY 2023-24

Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP513
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 applyingprinciples of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needsrelated 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 theawareness 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.	III	Apply
CO2	Analyse different gas turbine systems and their characteristics	IV	Analyze
CO3	Evaluate the performance of gas turbine systems.	V	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	**Centrifugal Compressors:** Principal of operation, work done and pressure rise. Vane-less space, slip factor, power input factor and Mach number at intake to impeller	7

III	**Axial Flow Compressor:** 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.	6
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.	6
VI	**Materials used in Gas Turbine**: Factors influencing selection of materials, materials used for different component like compressor component, combustion chamber, disc and rotors, turbine blades, nozzle, guide vanes, turbine casing and heat exchanges, Environmental Considerations and Applications, Failure analysis.	6

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, 3rdedition, 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. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP514
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 byapplying 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.	II	Remember
CO2	Apply knowledge of mathematics, science, and engineering for the needsin hydrodynamic machine design.	III	Apply
CO3	Carry out analysis and interpret results.	IV	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 of impeller inlet and outlet dimensions, meridional geometry inlet and exit blade angles, blade geometry, mixed flow pumps, elementarypump, design of twisted blade, design of volute, vane diffuser and return passage, suction spiral.	6

III	Axial flow pumps, selection of speed, pump casing geometry hub diameter, 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 diameter series, selection of type and diameter, Reaction turbine runner spaces, meridional velocity field, elementary turbines, Hydraulic design of Francis 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 lines to finalize the runner design, Guide wheel, Vane geometry and torque on controlling mechanism, Discharge and circulation, spiral, speedring, draft tube.	7
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.	6
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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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7HP515
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 applyingprinciples of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfil industrial needsrelated to low temperature systems.
3	To train students with effective communication skills to demonstrate air conditioningtheories.
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,		
CO1	Apply knowledge of mathematics, science and engineering for the needs inair-conditioning.	Apply
CO2	Analyze different Air-Conditioning systems and their characteristics.	Analyze
CO3	Evaluate the performance and interpret the report in the field of Air-Conditioning.	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, psychometricprocesses and their analysis, SHF, effective surface temperature and bypassfactor. Air quality required. Analysis of combination of processespsychometric system. Load Analysis: Inside design conditions, outside design conditions, sensible heat load and latent heat loads, heat gains from infiltration ventilation, solar radiation from walls, occupants and other sources. Heating load, Load estimation chart.	7

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.	7
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.	6
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 HillBook 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”, VanNostrand
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)

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information

Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	7HP516
Course Name	Design of Solar and Wind System
Desired Requisites:	Energy engineering

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

Course Objectives

1	To develop a comprehensive technological understanding in solar PV system components
2	To provide in-depth understanding of design parameters to help design and simulate the performance of a solar PV power plant
3	Learn principles and operational features of wind machines, wind data performance

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 the basics of solar energy conversion systems	III	Apply
CO2	Analyze a standalone PV system	IV	Analyze
CO3	Evaluate different wind energy conversion systems	V	Evaluate

Module	**Module Contents**	**Hours**
I	Energy scenario, Man and energy, World's production of commercial energy sources, India's production and reserves, Energy alternatives, The solar energy option	6
II	Thermal applications, Water heating, Space heating, Space cooling and refrigeration, Power generation, Distillation, Drying and Cooking, Concentrating collector, Central receiver system	6
III	Liquid flat plate collector, Performance analysis, Collection efficiency factor, Selective surfaces, Evacuated tube collector, BNL, Polymer and concrete collector, Solar air collector, types, performance analysis, Air heater with fins,	7
IV	Thermal energy storages, Sensible and latent heat storage, Solar ponds, Performance analysis, operational problems, Other solar pond concepts, Photovoltaic conversion, Performance characteristics, Commercial solar cell, cost and applications, prospects of PV cell for India	7
V	Wind energy fundamentals and applications, Merits, Limitations, Nature and origin of wind, Wind turbine theory, Power of wind turbine for given incoming wind velocity Vi, Wind to electric energy conversion system	7
VI	Classification and development of wind machines, Multi bladed type, Propeller type, wind machines, Wind data performance calculation, Concluding remarks, prospects of wind energy for India	6

Textbooks

1	S. Rao Dr. B. B. Parulekar, "Energy Technology – Nonconventional, Renewable & Conventional", Khanna Publishers
2	S.P. Sukhatme and J K Nayak, " Solar Energy" McGraw Hill Education
3	B. S. Mangal, " Solar Power Engineering", Tata McGraw Hill, New Delhi 1990
4	Spera D. A. 1994, "Wind Turbine Technology, Fundamentals of concept in wind turbine Engg." ASME ebook

References	
1	Culp, Archie W, “Principles of Energy Conversion”, McGraw Hill Book Company
2	Rabl. A. 1985, “Active solar collectors and their applications” Oxford University press
3	John A Duffie, W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley and Sons INC
4	Gary L. Johnson, “Wind Energy Systems”, Prentice Hall New Jersey
5	Sathyajith, Mathew, “Wind Energy Fundamentals, Resource Analysis and Economics”, springer verlag Berlin
6	Kloeffler R.G, Sitz E.L (1946), “Electric Energy from Winds” Kansas State College of Engg.,ManhattanKans
Useful Links	
1	https://nptel.ac.in/courses/103/103/103103206/

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

Walchand College of Engineering

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Vishrambag, Sangli-416415

1947

Course Content for F. Y. M. Tech. Mechanical (Heat Power Engineering)

Semester-II

2023-24

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP521
Course Name	Advanced 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	II	Understand
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	III	Applying
CO3	Design and develop controls and instrumentation for effective monitoring of the process	IV	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 in boilers, 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.	7

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.	6
IV	Boiler Performance Assessment Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boilerperformance.	7
V	Energy Conservation and Waste Minimization Energy conservation options in Boiler; waste minimization, methodology; economic viability of waste minimization.	6
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 Answes; TataMcGrawHill 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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Course Information

Programme	M. Tech. (Mechanical Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP522
Course Name	Computational Techniques 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.	6

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, 2nd edition, 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 Engineering Education 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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Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP523
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 applyingprinciples of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needsrelated 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 theawareness 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 needs in 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 and interpret 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,	6
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.	6
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	7

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,	7
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.	6
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	7

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. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP571
Course Name	Advanced Steam Engineering Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

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 experiment / mini-project, 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 Steam Engineering	III	Apply
CO2	Verify the concepts related to Steam Engineering.	IV	Analyse
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

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 steam engineering.

Textbooks

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

References

1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed National and International Journals and Conferences.

Useful Links

1	As per the need of the experiment/mini project.

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. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP572
Course Name	CFD Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

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 experiment / mini-project, 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 CFD	III	Apply
CO2	Verify the concepts related to CFD.	IV	Analyse
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

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 CFD.

Textbooks

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

References

1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed National and International Journals and Conferences.

Useful Links

1	As per the need of the experiment/mini project.

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. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP545
Course Name	Seminar
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To review and increase student's 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 seminar work should preferably be a problem with research potential, involve scientific research review, design, generation, collection, and analysis of data, determine a solution, and preferably bring out the individual contribution. The seminar should be based, preferably, on the area in which the candidate is interested to undertaking the dissertation work. The candidate has to be in regular contact with their guide, and the topic of the seminar must be mutually decided. The examination shall consist of the preparation of a report consisting of a literature review, a detailed problem statement, case studies, etc., according to the type of work carried out. The work has to be presented in front of the examiner panel formed by department for evaluation.

Textbooks

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

References

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

Useful Links

1	As per the need of the 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	7HP531
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 principlesof mathematics, science and engineering.
2	Prepare students to use modern tools, techniques and skills to fulfill industrial needsrelated to design of heat exchanger.
3	Develop skills in the analysis of heat exchanger with mathematical modeling forapplications in research or design.

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 for the needs in heat exchanger designing.	III	Apply
CO2	Analyze the thermal and Hydraulic design of different types of heat exchangers	IV	Analyze
CO3	Evaluate Heat Exchanger design	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Types of heat exchanger** Heat Exchangers – Classification according to transfer process, number of 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.	6
II	**Heat exchanger design methodology** Assumption for heat transfer analysis, problem formulation, e-NTU method, *P*-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamentalprocesses of fouling.	7
III	**Compact and Double Pipe Heat Exchangers** Thermal and Hydraulic design of compact heat exchanger. Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop.	6

IV	**Direct-contact heat exchanger, cooling towers** 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.	7
V	**Shell and Tube heat exchangers** Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers	6
VI	**Mechanical Design of Heat Exchangers** 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.	7

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 ThermalDesign" 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

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	7HP532
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 applyingprinciples of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needsrelated 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.

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	Apply
CO2	Analyse different Refrigeration systems and their characteristics	IV	Analyze
CO3	Evaluate the performance of different refrigeration systems	V	Evaluate

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	6
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	7
III	Reciprocating, scroll and screw compressor: Multistage industrialapplications, cylinder arrangement, cooling methods - oil injection	7

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	7
V	Vessels in industrial refrigeration: High pressure receiver - flash tank -liquid and vapor separator, separation enhancers, low pressure receivers, surge drum	6
VI	Conservation and design considerations - source of losses - critical thickness – insulation cost and energy cost - vapor barriers – construction methods of refrigerated spaces.	6

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 ProfessionalPublishing 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 Airconditioning and refrigeration- ISHRAE, ASHRAE.
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			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)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	M. Tech. (Heat Power Engineering)
Class, Semester	Second Year M. Tech., Sem II
Course Code	7HP533
Course Name	Food Preservation and Cold Chain Management
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 understand the importance microorganisms in food preservation
2	To introduce the basics of various food processing and preservation technologies
3	To know the need and importance of preservation in dairy and fishery industry.
4	To analyze the compositional and technological aspects of milk and fish and other food products
5	To apply study of food preservation for preservation of various food products.

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 the importance of microorganisms in food preservation. To introduce the basics of various food processing and preservation technologies	II	Understand
CO2	Identify food preservation for preservation of various food products and cold chain management	III	Applying
CO3	Analyse the compositional and technological aspects of milk and fish and other food products during preservation	IV	Analysing

Module	**Module Contents**	**Hours**
I	Food Microbiology: Principles of Food Preservation, microorganisms associated with foods bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of microorganisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelve stable foods.	7
II	Food Preservation by Low temperature Freezing and Refrigeration: Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food. Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.	7
III	Food Preservation by high temperature: Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.	6
IV	Food Preservation by Moisture control: Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry. Drying methods and equipment, air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, spray dryer, drum dryer, vacuum dryer, freeze drying ,foam mat drying. Evaporation-Definition, factors affecting evaporation, names of evaporators used in food industry.	7

V	Food Preservation by Irradiation and chemicals Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. Recent Trends Pulsed electric fields, High pressure technology, Ohmic heating, Microwave heating, Hurdle technology.	6
VI	Cold chain and Cold Chain Management Freezing: requirements of refrigerated storage - controlled low temperature, air circulation and humidity, changes in food during refrigerated storage, progressive freezing, changes during freezing – concentration effect and ice crystal damage, freezer burn. Maintenance of controlled environment during transportation and sales outlets.	6

Textbooks	
1	Potter NH, Food Science, CBS Publication, New Delhi, 1998.
2	Ramaswamy H and Marcott M, Food Processing Principles and Applications CRC Press,2006
References	
1	B. Srilakshmi, Food science, New Age Publishers,2002
2	Meyer, Food Chemistry, New Age,2004
3	Bawa. A.S, O.P Chauhanetal. Food Science. New India Publishing agency, 2013
4	Frazier WC and Westhoff DC, Food Microbiology, TMH Publication, New Delhi, 2004
5	Desrosier NW and Desrosier JN, The Technology of Food Preservation, CBS Publication, New Delhi, 1998
6	Paine FA and Paine HY, Handbook of Food Packaging, Thomson Press India Pvt Ltd, New Delhi- 1992
7	Toledo Romeo T, Fundamentals of Food Process Engineering, Aspen Publishers, 1999
Useful Links	
1	https://nptel.ac.in/courses/126/105/126105011/
2	https://nptel.ac.in/courses/126/103/126103017/

CO-PO Mapping

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

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information

Programme	M. Tech. (Mechanical Heat and Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP534
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 applyingprinciples of mathematics, science and engineering.
2	To prepare students to use modern tools, techniques and skills to fulfill industrial needsrelated 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/airconditioning/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	7
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	7
III	**Gas Separation and Purification** Gas separation and purification – principles, Gas separation systemsfor air, hydrogen	6

IV	**Cryocoolers** Cryogenic refrigeration systems, Ideal and practical systems, Joule-Thompson cryocoolers, Stirling Cycle Refrigerators,	7
V	**Cryogenic fluid storage and transfer systems** Cryogenic Dewar, Cryogenic Transfer Lines, Two phase flow incryogenic transfer system	6
VI	**Instrumentation and safety** Instrumentation in cryogenics to measure Flow, Level and Temperature	6

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 illustratededition 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 edition1962.
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	7HP535
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 analyze and solve air conditioning related problems by applyingprinciples 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 conditioningtheories.
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	Analyze 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.	7
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	7
III	Ventilation: Necessity; ventilation standards; natural and mechanical ventilation; forces for natural ventilation; general ventilation rules; determining ventilation requirement; use of decay equation.	6

IV	Air Cleaning: Physical and chemical vitiation of air; permissible concentration of air contaminants; mechanical and electronic aircleaners; dry and wet filters; radiators and convectors. Design of ayear-round air conditioning system.	6
V	Air handling Equipment: Fans & Duct System Characteristics, Fan Arrangement Variable Air Volume systems, Air Handling Units and FanCoil 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.	7
VI	Industrial Applications: Major uses of air conditioning for medium sized& large industrial buildings. Application of air conditioning inPharmaceutical, textile industry.	6

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/112/107/112107216/

CO-PO Mapping

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

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AY 2023-24

Course Information

Programme	M. Tech. (Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7HP536
Course Name	Energy Conservation and Management
Desired Requisites:	Environment Studies, Elements of Mechanical Engineering, Thermodynamics

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

Course Objectives

1	To emphasis the student to study and understand the energy data of industries.
2	To explain the problems energy accounting and balancing
3	To workout energy audit and motivate the students to suggest methodologies for energy savings.
4	To prepare the students utilize the available resources in optimal ways
5	To emphasis the student to study and understand the energy data of industries.

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 analyze the energy data of industries	II	Understand
CO2	Carryout energy accounting and balancing	III	Apply
CO3	Exercise energy audit and suggest methodologies for energy savings	IV	Analyse

Module	**Module Contents**	**Hours**
I	Commercial and non-commercial energy, Primary energy resources, Commercial energy production, Final energy consumption, Indian energy scenario, Sectorial energy consumption, Energy needs of growing economy, Energy intensity on purchasing power parity (PPP) basis, Long term energy scenario, Energy pricing, Energy security, Energy strategy for the future, Energy conservation and its importance	6
II	Energy auditing – methodology & analysis, Definition of energy management & its objectives, energy audit, need, types of energy audit, energy performance, matching energy use to requirements, maximizing systems efficiencies, energy audit instruments and metering.	7
III	Financial Management – Investment need, Appraisal and criteria Financial Analysis techniques, Simple Payback Period, Return On Investment, Net Present Value, Interest rate of return, Risk and sensitivity analysis, Financing Options, ESCOS.	7
IV	Energy Conservation in energy Intensive Industries. Cogeneration – Need, Principle, Technical Options for Cogeneration. Classification, Factors Influencing choice, Heat to Power ratios, Load Patterns, Prime movers used in Conservation. Advantages and Disadvantages of various systems. Case Studies	7
V	Energy and environment, Air pollution, Climate change, United Nations Framework Convection on Climate Change (UNFCCC), Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM methodology and procedure, Sustainable Development.	6
VI	Energy conservation in compressed air systems, HVAC & Refrigeration Systems, Fans, Blowers, Pumps & Pumping Systems, Cooling Towers, Lighting Systems	6

Textbooks	
1	Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004
References	
1	Energy Management: W.R.Murphy, G.Mckay (Butterworths)
2	Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation", Hemisphere Publ, Washington, 1988
3	Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford,
4	Management of Energy Environment Systems -W.K.Foell (John Wiley and Sons)
Useful Links	
1	
2	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2		2	
CO2	1		2		2	2
CO3	1			3		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 2023 -24

Course Information	
Programme	M. Tech. (Mechanical Heat Power Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7OE504
Course Name	Waste to Energy
Desired Requisites:	

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

Course Objectives

1	Understand the grave problem of urban solid waste disposal and methods to tackle this problem.
2	Understand and apply various energy conversion methods using biomass.
3	Study and analyze the biogas energy conversion process.
4	Study the Waste To Energy & Environmental Implications

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	Describe various methods of conversion of waste to energy.	II	Understand
CO2	Examine various methods of energy generation using waste	III	Apply
CO3	Explain the environment considerations of WTE plants the combustion mechanisms of various fuels	IV	Analyse

Module	**Module Contents**	**Hours**
I	Introduction – Waste production in different sectors such as domestic, industrial, agriculture, post-consumer, waste etc. Classification of waste-agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous), Characterization of waste for energy utilization, Characterization of wastes, Waste to energy by incineration process, Incineration plant furnaces & boilers.	7
II	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application. Manufacture of pyrolytic oils and gases, yields and applications.	6
III	Biomass Gasification: Gasifiers- Fixed bed system- Downdraft and updraft gasifiers, Fluidized bed gasifiers- construction and operation – Gasifier burner arrangement for thermal heating. Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation	7
IV	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, construction and operation.	7
V	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features Biochemical conversion - anaerobic digestion - Types of biogas Plants Applications - Alcohol production from biomass - Bio diesel production.	6
VI	Waste To Energy & Environmental Implications- Environmental standards for waste to energy plant operations and gas clean-up. Savings on non-renewable fuel resources. Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.	6

Text Books

1	S . P. Sukhatme, " Solar Energy", McGraw Hill Education, 3rd Edition,2015
2	Energy Technology- S. Rao and B. B. Parulekar, Khanna Publica
3	NIR Board 2004, Handbook on Biogas and its applications, NIIR, New Delhi.

References	
1	Annual Report 2006, Ministry of new and renewable energy, Government of India, New Delhi.
2	Energy Handbook, R. L. Loftness Van NOstrand Reinhold.
3	H. Shah et al., Integrated renewable energy for rural development, 1990, Tata Mc Graw Hill.
4	L..L. Anderson et al, Fuels from waste academic press, New york, 1977.
5	Rogoff, M.J. and Screve, F., "Waste-to-Energy: Technologies and Project Implementation", Elsevier Store
6	Young G.C., "Municipal Solid Waste to Energy Conversion processes", John Wiley and Sons
7	Harker, J.H. and Backhusrt, J.R., "Fuel and Energy", Academic Press Inc.
8	EL-Halwagi, M.M., "Biogas Technology- Transfer and Diffusion", Elsevier Applied Science
9	Hall, D.O. and Overeed, R.P.," Biomass - Renewable Energy", John Willy and Sons
10	Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
11	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
12	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
13	Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
Useful Links	
1	https://nptel.ac.in/courses/103103206
2	https://www.youtube.com/@wastetoenergyconversion2687
3	https://archive.nptel.ac.in/courses/103/107/103107125/

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