In Pursuit of Excellence	Course and Faculty Details	SESSION-2019-2020 SEM- 4th

Faculty Details

Name of the Faculty: **SHUBHAM VYAS**

Designation: **ASSISTANT PROFESSOR**

Department: **MECHANICAL ENGINEERING**

Course Details

Name of the Programme: **B.TECH.**

Batch: **2018-2022**

Branch: **MECHANICAL ENGINEERING**

Section: **E**

Name of Subject: **APPLIED THERMODYNAMICS**

Subject Code: **KME 401**

Category of Course: **CORE SUBJECT**

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In Pursuit of Excellence	**Index**	SESSION-2019-2020
		SEM- 4th

Dr. Munish Chhabra
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Deptt. of Mechanical Engg.
Moradabad Institute of Technology
Moradabad - 244001

Vision

To develop industry ready professional with values and ethics for global needs.

Mission

M1: To impart education through outcome based pedagogic principles.

M2: To provide conducive environment for personality development, training and entrepreneurial skills.

M3: To induct high professional ethics and accountability towards society in students.

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Vision

To develop competent and skilled Mechanical Engineers having moral values and ethics for the fulfilment of fast changing global needs.

Mission

M1: To nurture continuous enhancement in teaching learning process for imparting strong fundamental knowledge of core, engineering science, and interdisciplinary subjects to students.

M2: To provide state-of-the-art laboratories for providing hand-on experience of technology, and to provide platforms for leadership and overall personality development.

M3: To develop strong mentor-mentee relationship for the professional and personal growth of students and also to inculcate moral values and ethics for serving the society.

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Program Educational Objectives (PEOs):

The objectives of the Department are to produce graduates who will have the:

PEO1: Employability & entrepreneurial skills for making career in industries, academia, government services and as an entrepreneur.

PEO2: Potential to apply fundamental concepts of mechanical engineering, engineering science and practical training in solving engineering problems and to contribute in development of technologies.

PEO3: Skills to apply leadership, managerial and administrative qualities to lead the projects professionally and ethically.

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Program Outcomes

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling to complex engineering activities, with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Program specific outcomes (PSOs):

Mechanical Engineering graduates will be able to

PSO1: Identify and solve problems of thermal engineering, strength of materials, fluid mechanics, refrigeration & air conditioning, design, dynamics of machines, mathematics and engineering science.

PSO2: Get fundamental knowledge and hand-on experience of different manufacturing processes, material testing techniques and CAD/CAM tooling to apply in various industries.

PSO3: Learn quality and industrial management concepts, communication and soft skills along with other interdisciplinary subjects such as programming language, electrical engineering and basic electronics to enhance their employability.

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Moradabad Institute of Technology

Ramganga Vihar Phase – II, Moradabad

Date: 16-01-2020

ACADEMIC CALENDAR

Even Semester

Session: 2019 – 2020

S. No.	Particulars	Date	Responsibility
1.	**Time Table** (a) Display on Notice Boards (b) Distribution to concerned Teachers	 18 Jan 2020 18 Jan 2020	 O.C. Time Table
2.	Distribution of Students' lists to teachers	18 Jan 2020	Concerned HODs /O.C. Class
3.	Blow up submission to HODs	18 Jan 2020	Concerned Teachers
4.	**Registrations** (a) 2nd and 4th Semester (b) 6th and 8th Semester (b)List of unregistered students to various department (c) Notifying unregistered students for getting registered at the earliest (through class O.Cs, / Faculty)	 20 Jan 2020 21 Jan 2020 27 Jan 2020 29 Jan 2020	 Concerned Teachers OS Academic Concerned HODs
5.	**Commencement of Classes** (a) 2nd and 4th Semester (b) 6th and 8th Semester	 21 Jan 2020 22 Jan 2020	HODs and Concerned Teachers
6.	Announcement of Test series dates	30 Jan 2020	Dean Academics
7.	Procurement of stationary & materials for Test Series for full semester (a) Requirement (b) Actual Procurement	 10 Feb 2020 15 Feb 2020	Convener Test Series Committee O.S. Academics
8.	(a)Short attendance compilation before Class Test-1 (b) Information to parents (c)Undertaking form handed over to students (b)Collection of undertaking form	20 Feb 2020 21 Feb 2020 21 Feb 2020 22 Feb 2020	O.C. Class
9.	**1st Test Series**	**24, 25 and 26 Feb 2020**	
	Announcement of Test Series schedule, Invigilation Programme, Seating arrangement etc.	18 Feb 2020	Class Test Committee
	After completion of Test Series (a) Evaluation of test copies & showing of copies to students (b) Report of poor performance of students to class OCs (c)) Submission of test copies in Nodal Centre	 29 Feb 2020 29 Feb 2020 29 Feb 2020	 Concerned Teachers Concerned Teachers Concerned Teachers
10.	(a) Last date for submission of examination forms to office (b) Submission of forms to University	06 March 2020** 07 March 2020**	OS Academic to take timely action as per University directions.

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7.

11.	Mid Semester break	09 March to 11 March 2020	
12.	Announcement of dues list and its last date for clearing dues (Current semester)	25 March 2020	Accounts/ OS Academic
13.	(a)Short attendance compilation before Class Test-2 (b) Information to parents (c)Undertaking form handed over to students (b)Collection of undertaking form	01 April 2020 03 April 2020 03 April 2020 04 April 2020	O.C. Class
14.	**2nd Test Series**	**07, 08 and 09 April 2020**	
	Announcement of Test Series schedule, Invigilation Programme, Seating arrangement etc.	03 April 2020	Class Test Committee
	After completion of Test Series (a) Evaluation of test copies & showing of copies to students (b) Report of poor performance of students to class OCs (c)) Submission of test copies in Nodal Centre	 13 April 2020 13 April 2020 13 April 2020	 Concerned Teachers Concerned Teachers Concerned Teachers
15.	Filling of student feedback forms for current semester	22 April 2020	Concerned HODs
16.	Requirement of additional Faculty (to be conveyed to Director) (for even semester)	30 April 2020	Concerned HODs
17.	(a) Floating the electives for even semester (b) Last date for students choice	22 April 2020 23 April 2020	Concerned HODs
18.	Date up to which final attendance is to be counted	26 April 2020	Concerned teachers
19.	Submission of consolidated list of shortage of attendance to Director and information to Parents	27 April 2020	Class O.Cs
20.	**3rd Test Series**	**28,29,30 April 2020**	
	Announcement of Test Series schedule, Invigilation Programme, Seating arrangement etc.	23 April 2020	Class Test Committee
	After completion of Test Series (a) Evaluation of test copies & showing of copies to students (b) Report of poor performance of students to class OCs (c)) Submission of test copies in Nodal Centre	 04 May 2020 04 May 2020 04 May 2020	Concerned Teacher Concerned Teachers Concerned Teachers
21.	**Submission of sessional marks:** (a) Meeting of Dean Academics, , all HODs and Director regarding attendance and performance of students.	05 May 2020	Dean Academics
	(b) Checking of Teachers' Records by HODs	06 May 2020	Concerned HODs
	(c) Finalization of sessional marks	08 May 2020	Concerned Teachers
	(d) Submission of Award list after final checking and uploading to OS Academics for further necessary action	As per date announced by AKTU	HODs Concerned Teachers
22.	**Theory Examinations:** (a) Collection of Admit Cards / Roll Nos. from University (b) Preparation of Roll lists (c) Collection of stationery such as copies, practical copies drawing sheets, graph paper etc. from University. (c) Procurement of stationery and other materials locally as necessary.	As per AKTU schedule	OS Academics to take appropriate actions as per University directions.

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23.	**Practical Examinations:**	As per AKTU schedule	Concerned HODs
	(a) Appointment of Internal Examiners	3 days before the practical exam schedule	Concerned HODs
	(b) Obtaining list of panel of External Examiners from AKTU & preparation of schedule of practical examination.	As per AKTU schedule	OS Academics
	(d) Dispatch of letters/contacting the external examiners	Within 2 days of list obtained from AKTU	HODs and concerned teachers
24.	**Preparation for Even Semester** (a) Load Distribution by Department (b) Submission to O.C. Time Table	 15 May 2020 16 May 2020	 Concerned Coordinators O.C. Time Table
25.	Registration for odd semester (2020 – 21)	To be announced**	OS Academic

**May be revised as per AKTU Schedule.

16-01-2020
Dean Academics

Director

Copy to:

1. Chairman
2. Secretary
3. P.A. to Director for Director's folder
4. All HODs
5. DOSW
6. Controller of Examination
7. O.C. Time Table
8. Registrar
9. All Faculty Members through HODs
10. O.S. Academics
11. A.S. Examinations
12. Account Section
13. T & P Cell
14. Librarian
15. Convener Test Series

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In Pursuit of Excellence

Course Evaluation Scheme

SESSION-2019-2020

SEM- 4th

SEMESTER- IV													
Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KAS402/ KOE041-48	Maths IV/Engg. Science Course	3	1	0	30	20	50		100		150	4
2	KVE401/ KAS401	Universal Human Values/Technical Communication	3 / 2	0 / 1	0 / 0	30	20	50		100		150	3
3	KME401	Applied Thermodynamics	3	0	0	30	20	50		100		150	3
4	KME402	Engineering Mechanics	3	1	0	30	20	50		100		150	4
5	KME403	Manufacturing Processes	3	1	0	30	20	50		100		150	4
6	KME451	Applied Thermodynamics Lab	0	0	2				25		25	50	1
7	KME452	Manufacturing Processes Lab	0	0	2				25		25	50	1
8	KME453	Computer Aided Machine Drawing-II Lab	0	0	2				25		25	50	1
9	KNC402/ KNC401	Python Programming / Computer System Security	2	0	0	15	10	25		50			0
10		MOOCs (Essential for Hons. Degree)											
		Total										900	21

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SEMESTER-IV

APPLIED THERMODYNAMICS

L-T-P
3-0-0

Objectives:

- To learn about of I law for reacting systems and heating value of fuels.
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand about the properties of dry and wet air and the principles of psychrometry.
- To learn about gas dynamics of air flow and steam through nozzles.
- To learn the about reciprocating compressors with and without intercooling.
- To analyze the performance of steam turbines.

UNIT I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First lawanalysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flametemperature- Chemical equilibrium and equilibrium composition calculations using freeenergy.
Introduction and Otto, Diesel and Dual cycles.

UNIT II

Vapour Power cycles:
Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.
Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance.
Condenser: Classification of condenser, air leakage, condenser performance parameters.

UNIT IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.
Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles.

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Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines andtheir processes, Principle of rocket propulsion, Introduction to Rocket Engine.
Reciprocating compressors, staging of reciprocating compressors, optimal stage pressureratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Course Outcomes:

- After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
- They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
- They will be able to understand phenomena occurring in high speed compressible flows.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw hill india.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI.
5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
8. Theory of Stream Turbine by WJ Kearton.

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Syllabus

UNIT I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis, First law analysis of combustion reactions, Heat calculations using enthalpy tables, Adiabatic flame temperature, Chemical equilibrium and equilibrium composition calculations using free energy. Introduction of Otto, Diesel and Dual cycles.

UNIT II

Vapour Power cycles:

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration.

***Comparison with Carnot Cycle**

Fuels and Combustion: Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.

***Use of Orsat Apparatus**

UNIT III

Boilers: Classifications and working of boilers, boiler mountings and accessories, Draught and its calculations, air pre-heater, feed water heater, super heater, Boiler efficiency, Equivalent evaporation, Boiler trial and heat balance.

Condenser: Classification of condenser, air leakage, condenser performance parameters.

*** Cooling Tower and Cooling Pond**

UNIT IV

Steam and Gas Nozzles: Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Off design operation of nozzle, Shock waves stationary normal shock waves, Effect of friction on nozzle, Super saturated flow.

Steam Turbines: Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse

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reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine.

UNIT V

Gas Turbine: Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency, Deviation of actual cycles from ideal cycles.

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

***Turbofan**

Reciprocating compressors: staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Books and References:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw hill india.
2. Thermal Engineering by Mahesh M Rathore, Mc Graw Hill Education
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education.
4. Applied Thermodynamics by Venkanna And Swati, PHI.
5. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
6. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
7. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
8. Theory of Stream Turbine by WJ Kearton
9. Applied thermodynamics by Onkar Singh, New Age International.

* **Beyond the Syllabus**

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COURSE OUTCOMES

Once the student has successfully completed this course, he/she will be able to:

KME 401.1	Understand the concept of fuels and their analysis and heat calculations, and analyze air standard cycles.
KME 401.2	Analyze the vapor power cycles and their method of improvement and learn the concept of combustion and various heats involved.
KME 401.3	Understand the working of boiler and its mounting and accessories and condenser and analyze their performance
KME 401.4	Analyze the dynamics of flow through nozzle and understand the principles of steam turbine and analyze the energy conversion in steam turbine.
KME 401.5	Understand the principles and operation of gas turbine and jet propulsion and analyze the performance parameters in reciprocating compressors.

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In Pursuit of Excellence	**Course Delivery Method**	SESSION-2019-2020
		SEM- 4th

Name of Subject: Applied Thermodynamics

Subject Code: KME 401

Branch: Mechanical Engineering

Course Plan

Delivery Methods: Chalk & Talk, Power Point Presentation, Tutorials, Video Lectures, solving Numericals, Practicals, assignments, seminar, Brainstorming, Group Discussion/Interactive session.

Coverage of

Unit 1 by: - Chalk & Talk, Tutorials, solving Numericals, assignments.

Unit 2 by: - Chalk & Talk, Power Point Presentation, Tutorials, Video Lectures, solving Numericals, assignments and Practicals

Unit 3 by: - Chalk & Talk, Power Point Presentation, Tutorials, Video Lectures, solving Numericals, assignments and Practicals

Unit 4 by: - Chalk & Talk, Power Point Presentation, Tutorials, Video Lectures, solving Numericals, assignments and Practicals

Unit 5 by: - Chalk & Talk, Power Point Presentation, Tutorials, Video Lectures, solving Numericals, assignments and Practicals

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In Pursuit of Excellence	**Mapping**	SESSION-2019-2020 SEM- 4th

Mapping of Course Outcomes with POs and PSOs:

Sr. No	Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	KME 401.1	3	2	2	1		1						2	3		
2	KME 401.2	3	2	2	1		1						2	3		
3	KME 401.3	3	2	2	1		1						2	3		
4	KME 401.4	3	2	2	1		1						2	3		
5	KME 401.5	3	2	2	1		1						2	3		

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MECHANICAL ENGG. DEPARTMENT, FACULTY TIME TABLE -2019-20 (EVEN SEMESTER)

w.e.f. – 21/01/2020

FACULTY NAME – MR. SHUBHAM VYAS (SVY)

L	T	P	
5	0	11	= 16 HRS

TIME / DAY	9.00-10.00 am	10.00-11.00am	11.00 - 12.00 Noon	12.00-01.00pm	01.00-2.00pm	2.00-3.00pm	3.00-4.00pm	4.00-5.00pm
MON					L	KCE-201, 2ND B, CAEG LAB, A-310		
TUE	KME-401 (L) 4TH, E D-305				U	5.VP.04 2ND B.VOC. A Project, A-103	KME-451, 4TH, E1, ATD LAB	
WED			KME-401 (L) 4TH, E D-305		N			
THU					C	5.VP.04 2ND B.VOC. A Project, A-103	KCE-201 (L) 2ND B A-307	
FRI		KME-401 (L) 4TH, E D-305			H	KME-451, 4TH, E2, ATD LAB		
SAT			KME-401 (L) 4TH, E D-305			5.VP.04 2ND B.VOC. A Project, A-103		

Subject Code	Subject Name
KME-401	APPLIED THERMODYNAMICS
KME-451	APPLIED THERMODYNAMICS LAB
KCE 201	CAEG LAB
5.VP.04	PROJECT

(Atul Sharma) 18/1/2020
(Deptt. Coordinator Time-Table)

(Rakesh Kumar Gangwar) 18/01/20
(O.C.Time-Table)

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MORADABAD INSTITUTE OF TECHNOLOGY, MORADABAD

MECHANICAL ENGG. DEPARTMENT, FACULTY TIME TABLE -2019-20 (EVEN SEMESTER)

w.e.f. – 21/01/2020, UPDATED & W.E.F- 27/01/2020

FACULTY NAME – MR. SHUBHAM VYAS (SVY)

L T P
4 0 10 = 14 HRS

TIME / DAY	9.00-10.00 am	10.00-11.00am	11.00 - 12.00 Noon	12.00-01.00pm	01.00-2.00pm	2.00-3.00pm	3.00-4.00pm	4.00-5.00pm
MON					L	KCE-201, 2^{ND} B, CAEG LAB, A-310		
TUE	KME-401 (L) 4^{TH}, E D-305		RME 851, 8^{TH} E, SEMINAR, D-307		U	5.VP.04 2^{ND} B.VOC. A Project, A-103		
WED		RME 851, 8^{TH} E, SEMINAR, D-307		KME-401 (L) 4^{TH}, E D-305	N			
THU					C	5.VP.04 2^{ND} B.VOC. A Project, A-103		
FRI		KME-401 (L) 4^{TH}, E D-305	RME 851, 8^{TH} E, SEMINAR, D-307		H	5.VP.04 2^{ND} B.VOC. A Project, A-103		
SAT			KME-401 (L) 4^{TH}, E D-305			5.VP.04 2^{ND} B.VOC. A Project, A-103		

Subject Code	Subject Name
KME-401	APPLIED THERMODYNAMICS
RME 851	SEMINAR
KCE 201	CAEG LAB
5.VP.04	PROJECT

(Atul Sharma) 28/1/2020
(Deptt. Coordinator Time-Table)

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25/01/2020
(Rakesh Kumar Gangwar)
(O.C.Time-Table)

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MECHANICAL ENGG. DEPARTMENT, FACULTY TIME TABLE -2019-20 (EVEN SEMESTER)
w.e.f. – 21/01/2020, UPDATED & W.E.F- 27/01/2020
RE-UPDATED & W.E.F-28/01/2020

FACULTY NAME – MR. SHUBHAM VYAS (SVY)

L T P
5 0 10 = 15 HRS

TIME / DAY	9.00-10.00 am	10.00-11.00am	11.00 - 12.00 Noon	12.00-01.00pm	01.00-2.00pm	2.00-3.00pm	3.00-4.00pm	4.00-5.00pm
MON					L	KCE-201, 2ND B, CAEG LAB, A-310		
TUE	KME-401 (L) 4TH, E D-305		RME 851, 8TH E, SEMINAR, D-307		U	5.VP.04 2ND B.VOC. A Project, A-103		
WED		RME 851, 8TH E, SEMINAR D-307		KME-401 (L) 4TH, E D-305	N			
THU	KCE-201 (L) 2ND B A-307				C	5.VP.04 2ND B.VOC. A Project, A-103		
FRI		KME-401 (L) 4TH, E D-305	RME 851, 8TH E, SEMINAR, D-307		H	5.VP.04 2ND B.VOC. A Project, A-103		
SAT			KME-401 (L) 4TH, E D-305			5.VP.04 2ND B.VOC. A Project, A-103		

Subject Code	Subject Name
KME-401	APPLIED THERMODYNAMICS
RME 851	SEMINAR
KCE 201	CAEG LAB
5.VP.04	PROJECT

(Atul Sharma)
(Deptt. Coordinator Time-Table)

(Rakesh Kumar Gangwar)
(O.C.Time-Table)

27/01/2020

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	Lecture Plan & Course Coverage	SESSION-2019-2020
In Pursuit of Excellence		SEM- 4th

Total Period: 45

S. No.	No. of Periods	Topics/Sub Topics	Reference Books	CO Covered	Planned Date	Coverage Date	Sign
1.	1	Introduction to Course Educational Objective, Course Outcomes, Scheme, Adopted Syllabus, PEOs, POs, PSOs Pre-requisite, Vision & Mission of Institute and Department			21.01.20	21.01.20	[signature]
2.	1	Introduction to solid, liquid and gaseous fuels	[1,2,9]	CO1	22.01.20	22.01.20	[signature]
3.	1	Stoichiometry, Exhaust gas analysis, First law analysis of combustion reactions	[1,2,9]	CO2	24.01.20	24.01.20	[signature]
4.	1	Heat calculations using enthalpy tables, Adiabatic flame temperature	[1,2,9]	CO1	25.01.20	25.01.20	[signature]
5.	1	Chemical equilibrium and equilibrium composition calculations using free energy	[1,2,9]	CO1	28.01.20	28.01.20	[signature]
6.	1	Introduction of Otto, Diesel and Dual cycles	[1,2,9]	CO1	29.01.20	29.01.20 31.01.20	[signature]
7.	1	**Vapour Power cycles**: Rankine cycle	[1,2,9]	CO2	31.01.20	03.02.20	[signature]
8.	1	Rankine cycle with superheat reheat and regeneration	[1,2,9]	CO2	01.02.20	04.02.20	[signature]
9.	1	Exergy analysis, Effect of pressure and temperature on Rankine cycle	[1,2,9]	CO2	04.02.20	11.02.20	[signature]
10.	1	Feed water heaters, Binary vapour cycle	[1,2,9]	CO2	05.02.20	12.02.20	[signature]
11.	1	Combined cycles, Cogeneration ***Comparison with Carnot Cycle**	[1,2,9]	CO2	07.02.20	13.02.20	[signature]
12.	1	**Fuels and Combustion**: Combustion analysis	[1,2,9]	CO2	08.02.20	14.02.20	[signature]
13.	1	heating values, air requirement, Air/Fuel ratio	[1,2,9]	CO2	11.02.20	18.02.20	[signature]
14.	1	Standard Heat of reaction and Effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature. ***Use of Orsat Apparatus**	[1,2,9]	CO2	12.02.20	19.02.20	[signature]
15.	1	**Boilers:** Classifications and working of boilers	[1,2,9]	CO3	14.02.20	22.02.20	[signature]
16.	2	Boiler mountings and accessories	[1,2,9]	CO3	15.02.20	03.03.20 04.03.20	[signature]

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17.	2	Draught and its calculations	[1,2,9]	CO3	18.02.20	06.03.20 07.03.20	
18.	1	Boiler efficiency, Equivalent evaporation, Boiler trial and heat balance.	[1,2,9]	CO3	19.02.20	13.03.20	
19.	1	**Condenser**: Classification of condenser	[1,2,9]	CO3	22.02.20	23.03.20	
20.	1	Air leakage, Condenser performance parameters. *** Cooling Tower and Cooling Pond**	[1,2,9]	CO3	28.02.20	24.03.20 25.03.20 26.03.20	
21.	1	**Steam and Gas Nozzles:** Flow through Convergent and convergent-divergent nozzles	[1,2,9]	CO4	29.02.20	27.03.20 28.03.20	
22.	1	variation of velocity, area and specific volume	[1,2,9]	CO4	03.03.20	30.03.20 31.03.20 01.03.20	
23.	1	choked flow, throat area, Nozzle efficiency	[1,2,9]	CO4	04.03.20	03.04.20 04.04.20	
24.	1	Off design operation of nozzle, Shock waves stationary normal shock waves	[1,2,9]	CO4	06.03.20	07.04.20 08.04.20	
25.	1	Effect of friction on nozzle, Super saturated flow	[1,2,9]	CO4	07.03.20	09.04.20 11.04.20	
26.	1	**Steam Turbines**: Classification of steam turbine	[1,2,9]	CO4	13.03.20	15.04.20 16.04.20	
27.	1	Impulse and Reaction turbines	[1,2,9]	CO4	14.03.20	17.04.20 18.04.20	
28.	1	Staging, Stage and Overall efficiency, reheat factor, Bleeding	[1,2,9]	CO4	17.03.20	20.04.20 21.04.20	
29.	2	Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction	[1,2,9]	CO4	18.03.20	22.04.20 23.04.20 24.04.20 25.04.20	
30.	1	Impulse reaction turbines, state point locus, Losses in steam turbines	[1,2,9]	CO4	20.03.20	27.04.20 28.04.20	
31.	1	Governing of turbines, Comparison with steam engine.	[1,2,9]	CO4	21.03.20	29.04.20 30.04.20	
32.	1	**Gas Turbine**: Gas turbine classification	[1,2,9]	CO5	24.03.20	01.05.20 02.05.20	
33.	1	Brayton cycle, Principles of gas turbine	[1,2,9]	CO5	25.03.20	04.05.20 06.05.20	
34.	1	Gas turbine cycles with intercooling, reheat and regeneration and their combinations	[1,2,9]	CO5	27.03.20	08.05.20 09.05.20 11.05.20 12.05.20	
35.	2	Stage efficiency, Polytropic efficiency, Deviation of actual cycles from ideal cycles	[1,2,9]	CO5	28.03.20	13.05.20 14.05.20 15.05.20	
36.	1	**Jet Propulsion**: Introduction to the principles of jet propulsion	[1,2,9]	CO5	31.03.20	16.05.20	
37.	1	Turbojet and turboprop engines and their processes	[1,2,9]	CO5	17.04.20	18.05.20 19.05.20	

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38.	1	Principle of rocket propulsion, Introduction to Rocket Engine ***Turbofan**	[1,2,9]	CO5	18.04.20	20.05.20 21.05.20 22.05.20	[signature]
39.	1	**Reciprocating compressors**: staging of reciprocating compressors	[1,2,9]	CO5	21.04.20	22.05.20 26.05.20 27.05.20	[signature]
40.	1	Optimal stage pressure ratio, effect of intercooling	[1,2,9]	CO5	22.04.20	28.05.20 29.05.20 30.05.20	[signature]
41.	1	Minimum work for multistage reciprocating compressors	[1,2,9]	CO5	25.04.20	31.05.20 02.06.20 03.06.20	[signature]

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In Pursuit of Excellence	**Tutorial-1**	SESSION-2019-2020
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Tutorial 1 [CO - 1]

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Otto Cycle	04.02.20	05.02.20	(signature)

1. In an engine working on an ideal Otto cycle, the temperatures at the beginning and at the end of compression are 27°C and 327°C. Find the compression ratio and air standard efficiency of the engine. (Ans: r = 5.65, η_{otto} = 50%)
2. The pressure and temperature of air at the beginning of compression in an Otto Cycle is 103 kPa and 27°C, respectively. The heat added per kg of air is 1850 kJ. The compression ratio is 8. Determine maximum temperature, maximum pressure, thermal efficiency.(Ans: Max Temperature = 2992.8°C, Max Pressure = 89.7 bar, η = 56.4%)
3. A four stroke, four cylinder petrol engine of 250 mm bore and 375 mm stroke works on Otto cycle. The clearance volume is 0.01052 m^3. The initial pressure and temperature are 1 bar and 47°C. If the maximum pressure is limited to 25 bar, find the following:
   i) The air standard efficiency of the cycle.
   ii) The mean effective pressure. (Ans: η= 56.5%, p_m = 1.346 bar)
4. In a SI engine working on Ideal Otto Cycle, the compression ratio is 5.5. The pressure and temperature at the beginning of compression are 1 bar and 27°C, respectively. The peak pressure is 30 bar. Determine the pressure, temperature at the salient points, the air standard efficiency, and mean effective pressure.(Ans: P_2 = 10.877 bar, P_4 = 2.758 bar, T_2 =320.28°C, T_3 = 1363.33°C , T_4 = 554.42°C, η = 49.4%, p_m = 5.24 bar)
5. An engine working on Otto Cycle has a total volume of 0.45 m^3, pressure 1 bar and temperature 27°C at the beginning of the compression stroke. At the end of Compression stroke, the pressure is 11 bar and 210 kJ of heat is added at constant volume. Calculate:
   i) The pressure, temperature and volume at the salient points in the cycle.
   ii) Percentage clearance volume
   iii) Net work done per cyle
   iv) The ideal power developed by the engine if the number of working cycles per minute is 210. (Ans: P_3 = 21.4 bar, P_4 = 1.94 bar, T_2 =322.68°C, T_3 = 886°C , T_4 = 311°C, $V_2 = V_3$= 0.081 m^3; $\%V_c$ = 2.19%, w_{net} = 104.2 kJ, Power = 364.68 kW).

Assume C_p = 1.005 kJ/kg.K, C_v = 0.717 kJ/kg.K

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	Tutorial-2	SESSION-2019-2020
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Tutorial 1 [CO - 1]

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Diesel Cycle	11.02.20	12.02.20	[signature]

1. A diesel engine has a compression ratio of 18 and cut off take place at 5 % of the stroke. Calculate the air standard efficiency. (Ans: η = 63.877%)
2. An air standard Diesel cycle has a compression ratio of 14. The pressure at the beginning of the compression stroke is 1 bar and temperature is 300 K. The maximum cycle temperature is 2500 K. Determine the cut off ratio and thermal efficiency. (Ans: ρ= 2.9,η = 55%)
3. An engine works on Diesel cycle with an inlet pressure and temperature of 1 bar and 17°C. The pressure at the end of adiabatic compression is 35 bar. The ratio of expansion i.e., after constant pressure heat addition is 5. Calculate the heat addition, heat rejection and efficiency of the cycle. (Ans: q_{in} = 1233.9 kJ/kg, q_{out} = 556.67 kJ/kg, η = 54.88%)
4. Calculate the percentage loss in air standard efficiency of a Diesel engine with compression ratio 14 and if fuel cut off ratio is delayed from 5% to 8%. (Ans: %change = 2.1 %)
5. An engine operates on air standard Diesel cycle. The pressure and temperature at the beginning of compression are 100 kPa and 27°C. The compression ratio is 18. The heat added per kg of air is 1850 kJ. Determine the maximum pressure, maximum temperature, thermal efficiency, net work done and mean effective pressure of the cycle. Take c_p = 1.005 kJ/kg.K. (Ans: Max Pressure = 57.2 bar, Max Temperature = 2521°C, η =59.2%, w_{net} = 1095 kJ/kg, p_m = 13.46 bar)
6. In an air standard Diesel engine cycle with a compression ratio of 14, the condition of air at the start of the compression stroke are 1 bar and 300 K. After heat addition at constant pressure, the temperature rises to 2775 K. Determine the thermal efficiency of the cycle, net work done per kg of air and the mean effective pressure. (Ans: η =56.1%, w_{net} = 1078.48 kJ/kg, p_m = 13.49 bar)

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In Pursuit of Excellence	**Tutorial-3**	SESSION-2019-2020
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Tutorial 1 [CO - 1]

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Dual Cycle	12.02.20	12.02.20	[signature]

1. In an air standard dual cycle, the pressure and temperature at the beginning of compression are 1 bar and 57 °C, respectively. The heat supplied in the cycle is 1250 kJ/kg, two third of this being added at constant volume and rest at constant pressure. If the compression ratio is 16. Determine the maximum pressure, maximum temperature in the cycle, thermal efficiency and mean effective pressure. (Ans: Max Pressure = 104.77 bar, Max temperature = 2302.6 °C, η = 66.67 %, p_m = 9.38 bar)
2. The pressure and temperature at the beginning of compression in an air standard dual cycle are 1 bar and 30 °C, respectively. The compression ratio is 9. The maximum pressure in the cycle is limited to 60 bar. The heat is added during constant pressure process upto 4 % of the stroke. Assuming cylinder bore and stroke as 250 mm and 300 mm respectively. Determine:
   i) Air standard efficiency of the dual cycle.
   ii) Power developed, if the number of working cycle is 3 per second. (Ans. η = 57.4%, Power = 49.93 kW)

   For air, take C_v = 0.71 kJ/kg.K and C_p = 1.0 kJ/kg.K
3. The compression and expansion ratio of an oil working engine working on air standard dual cycle are 9 and 5, respectively. The initial pressure and temperature are 1 bar and 30 °C, respectively. The heat liberated at constant pressure is twice the heat liberated at constant volume. The expansion and compression follow the law $pV^{1.25}$ = Const. Determine:
   i) Pressure and temperature at all salient points (Ans: P_2 = 15.58 bar, $P_3 = P_4$ = 35.46 bar, P_5 = 4.74 bar, T_2 = 524.81 K, T_3 = 1194.56 K, T_4 = 2150.22 K, T_5 = 1438 K)
   ii) The mean effective pressure of the cycle. (Ans: p_m = 6.13 bar)
   iii) Thermal efficiency of the cycle (Ans: η = 43.5%)
   iv) Power developed in the cycle, if eight cycles completed in a second (Ans: Power = 96.33 kW)

   Take cylinder bore = 250 mm and stroke = 400 mm
4. A high speed oil engine operating on dual combustion cycle has a pressure of 1 bar and a temperature of 50 °C before compression. Air is then isentropically to 1/15th of its original volume. The maximum pressure is twice the pressure at the end of isentropic compression. If the cut off ratio is 2, determine the temperature at the end of each process and ideal efficiency of the cycle. Take γ = 1.4. (Ans: T_2 = 681.2°C , T_3 = 1635.4°C , T_4 = 3543.8°C , T_5 = 1431.8°C, η = 61.9%

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	Tutorial-4	SESSION-2019-2020
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Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date Batch A	Coverage Date Batch B	Sign
1.	1	Boiler Trial	24.03.20	24.03.20	[signature]

1. Calculate the equivalent evaporation from and at 100°C for a boiler, which receives water at 60°C and produces steam at 1.5 MPa and 300°C. The steam generation rate is 16000 kg/h. Coal is burnt at the rate of 1800 kg/h. The calorific value of coal is 34750 kJ/kg. Also calculate the thermal efficiency of the boiler. If the thermal efficiency of the boiler increases by 5% due to the use of economizer, find the saving in fuel per kg of hour.
2. A boiler generated 7.5 kg of steam per kg of coal burnt at a pressure of 11 bar from feed water having a temperature of 70°C. The efficiency of the boiler is 75% and factor of evaporation is 1.15. Specific heat of superheated steam at constant pressure is 2.3. Calculate:

a) Degree of superheat and temperature of steam generated.

b) Calorific value of coal in kJ/kg

c) Equivalent evaporation in kg of steam per kg of coal.

3. Calculate the efficiency of (a) boiler, (b) Economiser and (c) whole plant having the following data:

(a) Boiler : Mass of Feed water : 2060 kg/h, Mass of coal burnt: 227 kg/h, calorific value of coal: 30,000 kJ/kg, Enthalpy of steam produced: 2750 kJ/kg

(b) Economiser: Inlet temperature of feed water: 15°C, Exit temperature of feed water: 105°C, Atmospheric Air temperature: 18°C, Temperature of flue gases entering: 370°C, Mass of flue gases: 4075 kg/h, Specific heat of flue gases: 1.3 kJ/kg. °C

4. A boiler generates steam at the rate of 6000kg/h at a pressure of 800 kPa with a dryness fraction of 0.98. The feed water is supplied at 40°C. If the efficiency of the boiler is 75%, calculate the rate of coal consumption, which has a calorific value of 31000 kJ/kg. What is the equivalent evaporation from this boiler? If the super heater is used with the boiler and temperature of superheated steam reaches 250°C, then find equivalent evaporation and efficiency of boiler. (Take C_{ps} = 2.27 kJ/kg°C)

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Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Boiler : Draught	09.04.20	09.04.20	[signature]

1. Find the minimum height of the chimney required to produce a draught of 16 mm of H_2O, if 19kg of air is required per kg of the fuel burnt on the grate. The mean temperature of flue gases inside the chimney is 330°C and the atmospheric temperature is 30°C.
2. A thermal power station works on natural draught. The height of chimney is restricted to 40m. The ambient temperature of the air is 20°C and the temperature of the flue gas passing through the chimney at its base is 300°C. The air fuel ratio is 17:1. Calculate the diameter of the chimney at the base, if the head lost due to friction is 25% of the ideal draught.
3. A boiler uses 16kg of air per kg of fuel, when the fuel consumption is at the rate of 1800 kg/h. Actual draught is 20mm of water when all losses are considered. The surrounding air temperature is 27°C and the flue gas temperature is 277°C. Determine the chimney height and its diameter, if actual velocity of the flue gases is 0.35 times the theoretical velocity due to roughness of interior surfaces of the chimney.
4. A boiler is equipped with a chimney of 30m height. The ambient temperature is 25°C. The temperature of flue gases passing through the chimney is 300°C. If the flow is 20kg/kg of fuel burnt. Find
   a. Draught Produced
   b. The velocity of flue gases through chimney if 50% of the theoretical draught is lost in friction
5. Find the mass flow rate of the flue gases through the chimney when the draught produced is equal to 20mm of water column. The temperature of gases is 300°C and the ambient temperature is 30°C. The mass of air used is 19 kg per kg of fuel burnt. Diameter of the chimney is 2m. Neglect the losses.
6. How much air is used per kg of coal burnt in a boiler having a chimney of 35m height to create a draught of 20mm of water? The temperature of gases in the chimney is 370°C and the boiler house temperature is 34°C. Does this chimney satisfy the condition of maximum discharge? Also, find the height of hot gas column under maximum condition of discharge.
7. A 40m high chimney is discharging flue gases at 350°C, when the ambient temperature is 30°C. The quantity of air supplied is 18kg per kg of fuel burnt. Determine:
   a. Draught produced in mm of water
   b. Equivalent draught in meters of hot gas column
   c. Efficiency of the chimney, if minimum temperature of artificial draught is 150°C; the mean specific heat of flue gases is 1.005 kJ/Kg.K
   d. The percentage of the heat spent in natural draught system, if the net calorific value of the fuel supplied is 30600 kJ/kg
   e. The temperature of chimney gases for maximum discharge in a given time and what would be the corresponding draught in mm of water produced.

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In Pursuit of Excellence	**Tutorial-6**	SESSION-2019-2020
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Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Fuel and Combustion	22.04.20	22.04.20	[signature]

1) Determine the air fuel ratio and the theoretical amount of air required by mass for complete combustion of a fuel containing 85% of carbon, 8% of carbon, 3% of oxygen, 1% of sulphur and remaining as ash. If 40% excess air is used, what is the volume of air at 27°C and 1.05 bar pressure?
2) The gravimetric analysis of a sample of coal gives 80% of carbon, 12% of H_2 and 8% of ash. Calculate the theoretical air required and analysis of products by volume.
3) A sample of dry anthracite has the following composition by mass:

   C = 90%, H = 3%, O = 2.5%, N = 1%, S = 0.5% Ash = 3%. Calculate:

   a) Stoichiometric Air fuel Ratio
   b) The actual air fuel ratio and dry and wet analysis of products of combustion by mass and volume when 20% excess air is supplied.
4) The gravimetric analysis of coal gives 80% of carbon, 8% of hydrogen, 4% of moisture and 8% of ash. Actual air supplied is 18kg per kg of coal. Calculate the theoretical amount of air required. If 80% of carbon is burned by CO_2 and the remaining to CO. Also the volumetric composition of dry products of combustion.
5) A producer gas has the following percentage composition by volume, H_2 = 15%, CH_4 = 2%, CO = 20%, CO_2 = 6%, O_2 = 3% and N_2 = 54%. If 50% excess air is supplied for combustion, determine the volume of air supplied per m^3 of gas and volumetric analysis of the combustion products.
6) A gas engine is supplied with natural gas of the following composition. CH_4 = 93%, C_2H_6 = 3%, N_2 = 3%, CO = 1%. If the A/F ratio is 30 by volume, calculate the analysis of the dry products of combustion. It can be assumed that the stoichiometric A/F ratio is less than 30.
7) Determine the air fuel ratio on both mass and molar basis for the complete combustion of Octane (C_8H_{18}) with (a) Theoretical amount of air (b) 150% theoretical air.

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Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Condenser	07.05.20	07.05.20	[signature]

Q.2 The following data refers to a test of the surface condenser of a steam turbine:
Absolute pressure of the steam entering the condenser = 5.628 kPa
Temperature of condensate leaving the condenser = 32°C
Inlet Temperature of Cooling Water = 15°C; Outlet Temperature of Cooling Water = 30°C
Mass of cooling water per kg of steam = 32kg
Assume that all the heat lost by the exhaust steam is taken up by the circulating water; determine the dryness fraction of the steam as it enters the condenser.

Q.3 The steam is supplied to a turbine at 3.0 MPa and 300°C. The expansion of steam is carried out isentropically to a condenser vacuum of 73 mm of Hg. The barometer reads 758 mm of Hg. The condenser temperature is 20°C and rise in temperature of cooling water is 12°C. Determine:
Quality of steam entering the condenser and quantity of cooling water circulate per kg of steam.

Q.4 The following data were recorded from a test of surface condenser:
Inlet temperature of cooling water = 21°C; Exit temperature of cooling water = 35°C
Vacuum in the condenser = 704.7 mm of Hg; Barometer Reading = 760 mm of Hg
Calculate the efficiency of condenser.

Q.5 Steam enters a condenser at 35°C. The barometer reading is 760 mm of mercury. If the vacuum of 690 mm is recorded, calculate the vacuum efficiency

Q.6 3000 kg of wet steam with a dryness fraction of 0.95 is condensed per hour in a barometric condenser. The minimum height of the tail race above the hot well is 8.5m. The barometric pressure is 760mm of Hg. The cooling water enters the condenser at 25°C and the mixture of condensate and cooling water exit temperature is 50°C. Calculate:
Vacuum in the condenser in mm of Hg; Absolute pressure in the condenser in kPa; Mass of cooling water required without undercooling.

Q.7 A vacuum of 710 mm of Hg was recorded in a condenser when the barometer reads 755 mm of Hg. The temperature of the condensate was 25°C. Calculate the pressure of steam and air in the condenser and mass of air per kg of steam. Also, calculate the vacuum efficiency.

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In Pursuit of Excellence	**Tutorial-8**	SESSION-2019-2020 SEM- 4^{th}

Sr. No.	No. of Periods	Topics/Sub Topics	Coverage Date		Sign
			Batch A	Batch B	
1.	1	Gas Turbine	18.05.20	18.05.20	[signature]

1. In a gas turbine plant, air enters the compressor at 15°C and it is compressed through a pressure ratio of 4 with isentropic efficiency of 85%. The air fuel ratio is 80 and the calorific value of fuel is 42000kJ/kg. The turbine inlet temperature is 1000K and the isentropic efficiency of the turbine is 82%. Calculate the overall efficiency and air intake for a power output of 260kW. Take the mass of fuel in account.
2. Calculate the required air fuel ratio in a gas turbine plant, whose turbine and compressor efficiencies are 85 and 80%, respectively. Maximum cycle temperature is 875°C. The working fluid can be taken as air (C_p = 1.0 kJ/kg.K and γ = 1.4), which enters the compressor at 1 bar and 27°C. The pressure ratio is 4. The fuel used has a calorific value of 42000 kJ /kg. There is a loss of 10% of calorific value in combustion chamber.
3. In a gas turbine the compressor takes in air at a temperature of 15°C and compresses it to 4 times the initial pressure with an isentropic efficiency of 85%. The air is then passed through a heat exchanger, heated by the turbine exhaust before reaching the combustion chamber. The turbine inlet temperature is 600°C and its efficiency is 80%. Neglect all losses except mentioned and treating the working fluid throughout the cycle to have the properties of air, calculate the thermal efficiency and work ratio of the cycle if (a) heat exchanger is perfect and (b) heat exchanger gives 85% of available heat to air.
4. In a gas turbine plant, air at 10°C and atmospheric pressure is compressed through a pressure ratio of 4. In a heat exchanger and combustion chamber, air is heated to 700°C with a pressure drop of 0.14 bar. After expansion through the turbine, the air passes through the heat exchanger, which cools the air through 75% of maximum range possible and air is finally discharged to the atmosphere. The isentropic efficiency of turbine and compressor are .85 and .8 respectively.Calculate the thermal efficiency of the plant.
5. In a gas turbine plant the compressor is driven by a high pressure turbine. The exhaust from high pressure turbine enters the low pressure turbine which runs the load. The air flow rate is 20 kg/s and minimum and maximum temperatures in the cycle are 300K and 1000K, respectively. The compressor ratio is 4. Calculate the pressure ratio low pressure turbine, temperature of exhaust of exhaust gases from the unit and the thermal efficiency of the plant. Compression and expansion are isentropic. C_p for air and exhaust gases can be taken as 1 kJ/kg.K and γ = 1.4
6. The following data refers to a gas turbine plant: Power developed = 5 MW; Inlet pressure and temperature of air to compressor = 1bar and 30°C; Pressure ratio of the cycle = 5; isentropic efficiency of compressor = 80%; isentropic efficiency of turbines = 85%; Maximum temperature in the turbine = 550°C, Take for air, C_p = 1.0 kJ/kg.K and γ = 1.4 and for gases C_p = 1.15 kJ/kg.K and γ = 1.33. If a reheater is used between two turbines at a pressure of 2.24 bar, calculate the following: (a) mass flow rate of air and (b) overall efficiency.

Name & Sign. of Faculty **Sign. of Reviewer** **Sign. of HOD**

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In Pursuit of Excellence	ASSIGNMENT - 3	SESSION-2019-2020
		SEM- 4^{th}

1. In an air standard dual cycle, the pressure and temperature are 0.1 MPa and 27 °C. The compression ratio is 18. The pressure ratio for the constant volume part of heating process is 1.5 and the volume ratio for the constant pressure part of heating is 1.2, determine (a) thermal efficiency, (b) mean effective pressure in MPa. (Ans: η = 68%, p_m = .527 MPa)
2. A four cylinder, four stroke engine has a displacement volume of 300 cc per cylinder. The compression ratio of the engine is 10 and operates at the speed of 3000 r.p.m. The engine is required to develop an output power of 40 kW at this speed. Calculate thermal efficiency of the cycle, assuming that the engine operates on Otto cycle and that the pressure and temperature at the inlet condition are 1 bar and 27 °C, respectively.
   If the above engine is operating on the diesel cycle and receiving heat at the same rate, calculate thermal efficiency and maximum temperature of the cycle. Compare the efficiency of Otto and Diesel cycle. (Ans : η_{otto} = 60 %; η_{diesel} = 46.7 %, Maximum Temperature = 2195 °C)

In Pursuit of Excellence	ASSIGNMENT - 4	SESSION-2019-2020
		SEM- 4^{th}

1. Calculate the equivalent evaporation of a boiler per kg of coal fired, if the boiler produces 50,000 kg of wet steam per hour with a dryness fraction of .95 and operating at 10 bar. The coal burnt per hour in the furnace is 5500 kg and feed water temperature is 40°C.
2. The following reading was recorded during a boiler trial:
   Feed Water: 2400kg/h; feed water temperature: 33°C; feed water temperature: 42°C; fuel used: 205kg/h
   Composition of fuel by mass: C = 84%, H_2 = 9.27%, O_2 = 6.73%
   Calorific value of fuel: 39500 kJ/kg; Average Chimney Temp: 307°C; Height of chimney: 32m; Steam pressure: 11.054 bar (gauge); Barometric Pressure: 710mm of Hg; Steam Condition: 0.96
   Calculate: (a) Boiler Efficiency (b) Equivalent evaporation from and at 100°C (c) Draught produced in mm of water.

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In Pursuit of Excellence	**ASSIGNMENT - 5**	SESSION-2019-2020 SEM- 4^{th}

1. A thermal power plant has a chimney draught of 3.5 cm of H_2O column. The flue gas temperature flowing through the chimney is 280°C and the ambient air temperature is 15°C. The amount of air supplied per kg of the fuel is 20kg.Calculate the height of chimney.
2. Compare the fan power input for forced and induced draught fans and also compare the quantity of heat carried away by flue gases per kg of fuel fired in each case. Assume specific heat of flue gases is 1.005 kJ/kg.K

Types of Draught	Outside Air Temperature, °C	Flue Gas Leaving Boiler Temperature, °C	Mass of air in kg/ kg of fuel
Forced Draught	27	150	15
Induced Draught	27	150	15
Chimney Draught	27	370	20

In Pursuit of Excellence	**ASSIGNMENT - 6**	SESSION-2019-2020 SEM- 4^{th}

1. Calculate the theoretical air to fuel ratio on molar and mass basis for the following fuels:
   i) Pure Carbon
   ii) Pure Hydrogen
   iii) Petrol ($C_{8.5}H_{18.4}$)
   iv) Heptane (C_7H_{16})
   v) Methanol (CH_3OH)
2. A steam boiler uses pulverized coal in the furnace. The ultimate analysis of coal by mass is given as: C= 78%, H_2 =3%, O_2 = 3%, S = 1%, Ash = 10%, Moisture = 5%. Excess air supplied is 30%. Calculate the mass of air to be supplied and mass of products of combustion per kg of coal burnt.

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In Pursuit of Excellence	ASSIGNMENT - 7	SESSION-2019-2020 SEM- 4th

1. A surface condenser is designed to handle 12000kg of steam per hour. The steam enters at 8kPa, 0.9 dry. The condensate leaves the condenser at the corresponding saturation temperature. Calculate the rate of cooling water, if cooling water temperature rises is limited to 12°C.
2. During the trial on a condenser, the following readings was recorded:
   Barometer reading = 766mm of Hg; Actual Vacuum recorded by gauge = 716 mm of Hg
   Temperature of exhaust steam = 35°C; Temperature of hot well = 29°C
   Inlet temperature of cooling water = 15°C; Outlet temperature of cooling water = 24°C
   Calculate: Corrected vacuum to standard barometer reading; Vacuum Efficiency; Undercooling of condensate; Condenser Efficiency.

In Pursuit of Excellence	ASSIGNMENT - 8	SESSION-2019-2020 SEM- 4th

1. A gas turbine unit has a pressure ratio of 6 and maximum cycle temperature of 610°C. The isentropic efficiency of turbine and compressor are .82 and .8 respectively. Calculate the power output in kW of an electric generator, geared to the turbine, when air enters the compressors at 15°C at a rate of 16kg/s. Take C_p = 1.005 kJ/kg.K and γ = 1.4 for compression process and C_p = 1.11 kJ/kg.K and γ = 1.333 for expansion process.
2. The air supplied to a gas turbine is 10kg/s. The pressure ratio is 6 and pressure at the inlet of compressor is 1 bar. The compressor is two stage and is provided with perfect intercooling. The inlet temperature is 300K and maximum temperature is limited to 1073K. Take the following data: Isentropic efficiency of compressor at each stage = 80%; Isentropic efficiency of turbine = 85%. A regenerator is included in plant whose effectiveness is 0.7 Neglecting the mass of fuel, determine the thermal efficiency of the plant.Q1. Calculate the equivalent evaporation of a boiler per kg of coal fired, if the boiler produces 50,000 kg of wet steam per hour with a dryness fraction of .95 and operating at 10 bar. The coal burnt per hour in the furnace is 5500 kg and feed water temperature is 40°C.

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In Pursuit of Excellence

List of Students

SESSION-2019-2020

SEM-

S.No	Student No	Roll No	Name of Students	Father's Name	Remark
1.	1840259	1808240001	AARAV SANKET	VIJAY KUMAR	
2.	1840003	1808240003	ABHINEET BHARDWAJ	KRISHAN KUMAR	
3.	1840058	1808240004	ABHISHEK BHATNAGAR	J.K. BHATNAGAR	
4.	1840047	1808240005	ABHISHEK SINGH	KASHI NATH SINGH	
5.	1840237	1808240006	AJAY KUMAR	INDRAPAL SINGH	
6.	1840258	1808240007	AMAN GAHLAUT	SATYAPAL SINGH	
7.	1840152	1808240008	ANMOL SAGAR	SURENDRA SAGAR	
8.	1840175	1808240009	APURV CHANDEL	ASHISH CHANDEL	
9.	1840157	1808240010	ARPIT TYAGI	AVNISH KUMAR TYAGI	
10.	1840104	1808240011	ATIGYA GARG	SHARAD KUMAR GARG	
11.	1840092	1808240012	DEEPAK PAL	SHIVNANDAN SINGH	
12.	1840008	1808240013	DEEPRANSH SINGH	DEEPENDRA SINGH	
13.	1840239	1808240014	DEVISH KUMAR	CHHATTARPAL SINGH	
14.	1840121	1808240015	DHARMESH DHAWAN	SUNIL KUMAR DHAWAN	
15.	1840260	1808240018	IBRAHIM KHAN	QAMAR HASEEN	
16.	1840127	1808240019	KARTIK CHAUDHARY	RAJVEER SINGH	
17.	1840163	1808240020	KRISHNA OMPRAKASH KASHYAP	OMPRAKASH BABURAM KASHYAP	
18.	1840122	1808240021	LAKSHAY KAUSHIK	PRAVEEN KAUSHIK	
19.	1840267	1808240022	LOKENDRA	RAM PAL SINGH	
20.	1840128	1808240023	MANJUL KUMAR	RAVI PRAKASH	
21.	1840246	1808240025	MAYANK ANAND	BRIJ BHUSHAN RAVI	
22.	1840137	1808240027	MOHD. RAHIL	MOHD. HANEEF	
23.	1840007	1808240028	MUSKAN BHATNAGAR	KULDEEP BHATNAGAR	
24.	1840264	1808240029	NIPUN VASHISHTHA	DAKSH KUMAR SHARMA	
25.	1840206	1808240030	PRANJAL CHAUDHARY	VIKAS KUMAR	
26.	1840266	1808240031	RAHUL ANAND	MUKESH ANAND	
27.	1840129	1808240032	ROMESHWAR SARAN	OMKAR SARAN	
28.	1840233	1808240033	SAMAN ALI	MOHD. ALI	
29.	1840016	1808240034	SAMYAK JAIN	NEERAJ JAIN	
30.	1840012	1808240035	SHANTANU TIWARI	ANADI TIWARI	
31.	1840173	1808240036	SUDHEER KUMAR GAUTAM	JAVAR SINGH	
32.	1840126	1808240037	UDAY VARSHNEY	SANDEEP KUMAR	
33.	1840084	1808240038	YASIR MUMTAZ	MUMTAZ HUSAIN	
34.	1810078	1808210024	ANANT BANSAL	ANUP BANSAL	
35.	2194003	1900820409001	AMAN KUMAR	ABHILASH CHANDRA	
36.	2194015	1900820409002	ANKIT PAL	JAYPAL SINGH	
37.	2194020	1900820409003	MUNISH HUSSAIN SIDDIQUI	INTEZAR HUSSAIN	

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Record of Monthly Attendance

SESSION-2019-2020

SEM- 4th

S.No	Roll No	Name of Students	H	A
1.	1808240001	AARAV SANKET	20	18
2.	1808240003	ABHINEET BHARDWAJ	20	12
3.	1808240004	ABHISHEK BHATNAGAR	20	14
4.	1808240005	ABHISHEK SINGH	20	12
5.	1808240006	AJAY KUMAR	20	09
6.	1808240007	AMAN GAHLAUT	20	15
7.	1808240008	ANMOL SAGAR	20	14
8.	1808240009	APURV CHANDEL	20	16
9.	1808240010	ARPIT TYAGI	20	16
10.	1808240011	ATIGYA GARG	20	13
11.	1808240012	DEEPAK PAL	20	15
12.	1808240013	DEEPRANSH SINGH	20	17
13.	1808240014	DEVISH KUMAR	20	20
14.	1808240015	DHARMESH DHAWAN	20	17
15.	1808240018	IBRAHIM KHAN	20	17
16.	1808240019	KARTIK CHAUDHARY	20	13
17.	1808240020	KRISHNA OMPRAKASH KASHYAP	20	11
18.	1808240021	LAKSHAY KAUSHIK	20	16
19.	1808240022	LOKENDRA	20	06
20.	1808240023	MANJUL KUMAR	20	11
21.	1808240025	MAYANK ANAND	20	11
22.	1808240027	MOHD. RAHIL	20	15
23.	1808240028	MUSKAN BHATNAGAR	20	19
24.	1808240029	NIPUN VASHISHTHA	20	16
25.	1808240030	PRANJAL CHAUDHARY	20	05
26.	1808240031	RAHUL ANAND	20	10
27.	1808240032	ROMESHWAR SARAN	20	16
28.	1808240033	SAMAN ALI	20	13
29.	1808240034	SAMYAK JAIN	20	17
30.	1808240035	SHANTANU TIWARI	20	12
31.	1808240036	SUDHEER KUMAR GAUTAM	20	15
32.	1808240037	UDAY VARSHNEY	20	13
33.	1808240038	YASIR MUMTAZ	20	12
34.	1808210024	ANANT BANSAL	20	19
35.	1900820409001	AMAN KUMAR	20	11
36.	1900820409002	ANKIT PAL	20	08
37.	1900820409003	MUNISH HUSSAIN SIDDIQUI	20	07

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MORADABAD INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
Sessional Test-1

Course: B.Tech	Semester: 4rth
Session: 2019-20	Section: E
Subject: Applied Thermodynamics	Subject Code: KME-401
Max Marks:15	Time: 1hour 15 Minutes

SET-1

Ques.No.	1	2	3	4	5	6
CO	2	2	1	1	2	2

SECTION – A

Q.1.	Define Heat Rate and Steam Rate with mathematical expressions.	02
Q.2.	What are the various losses associated with vapour power cycle? Explain with the help of T-S Diagram.	02
Q.3.	Develop an expression for the thermal efficiency of Otto Cycle in terms of compression ratio.	02

SECTION – B

Q.4.	In an air- standard Diesel engine cycle with a compression ratio of 14, the condition of air at the start of compression stroke are 1 bar and 300 K. After addition of heat at constant pressure, the temperature rises to 2775 K. Determine the thermal efficiency of the cycle, net work done per kg of air.	03
Q.5.	A steam power plant operates on ideal Rankine cycle. The steam enters the turbine at 3 MPa, 350°C and is condensed in the condenser at a pressure of 75kPa. Determine the thermal efficiency, back work ratio and work ratio of this cycle.	03
Q.6.	The steam is supplied to a turbine at a pressure of 32 bar and a temperature of 410°C. If the steam is reheated at 5.5 bar to a temperature of 395°C and then expands isentropically to 0.08 bar, what will be the dryness fraction and thermal efficiency of the cycle?	03

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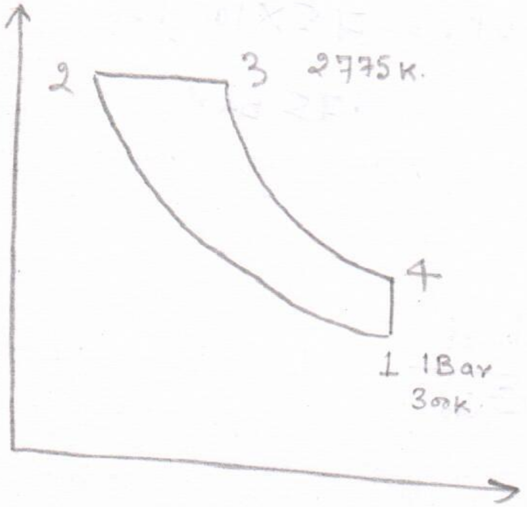
Q.4. Ans.

$P_1 = 1\,bar$. $T_3 = 2775\,K$.

$T_1 = 300\,K$ $r \Rightarrow 14$



$T_2 \Rightarrow T_1 (r)^{\gamma-1}$

$\Rightarrow 300 (14)^{1.4-1}$

$= \underline{862.13\,K.}$

$\frac{T_3}{T_2} = \frac{v_3}{v_2} = \rho.$

$\rho \Rightarrow \frac{v_3}{v_2} = \frac{2775}{862.13} = \underline{3.219}$

$\eta \Rightarrow 1 - \frac{1}{r^{\gamma-1}} \left[\frac{\rho^{\gamma} - 1}{\gamma(\rho - 1)} \right]$

$= 1 - \frac{1}{(14)^{1.4-1}} \left[\frac{(3.219)^{1.4} - 1}{1.4\,(3.219 - 1)} \right]$

$= .53647 = \underline{53.65}\%$

$Q_{in} = C_p (T_3 - T_2)$

$\Rightarrow 1.005 (2775 - 862.13) \Rightarrow \underline{1922.43}\ KJ/kg.$

$W_{net} = \eta \cdot Q_{in}$

$= .53647 \times 1922.43 = \underline{1031.33}\ KJ/kg.$

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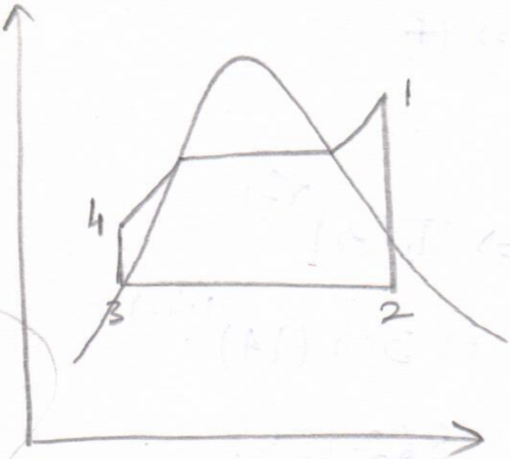
Q.5.



$P_1 = 3MPa \Rightarrow 30\,bar$

$T_1 = 350°c$

$P_2 = 75\,kPa = 75 \times 10^3\,Pa.$

$= .75\,bar$

$\eta \Rightarrow \frac{W_{net}}{Q_{in}}$

$P_1 = 30\,bar$

$T_1 = 350°c$

$s_1 = 6.747\,kJ/kg.k.$

$h_1 = 3117.5\,kJ/kg.$

$P_2 = .75\,bar.$

$h_f \Rightarrow 384.4\,kJ/kg.$

$h_{fg} \Rightarrow 2278.6\,kJ/kg.$

$s_f = 1.213\,kJ/kg.k.$

$s_{fg} = 6.244\,kJ/kg\,k.$

$v_f = .0010375\,m^3/kg.$

$s_1 = s_2 \Rightarrow s_f + x\,s_{fg}$

$6.747 = 1.213 + x(6.244)$

$x = .886$

$h_2 = 384.4 + .886 \times 2278.6 \Rightarrow 2402.84\,kJ/kg.$

$h_3 = 384.4\,kJ/kg$

$W_p = v(P_1 - P_2) \Rightarrow .0010375(3000 - 75)$

$\Rightarrow 3.035\,kJ/kg$

$h_4 = h_3 + W_p = 384.4 + 3.035 = 387.435$

$Q_{in} \Rightarrow h_1 - h_4$

$\Rightarrow 3117.5 - 387.435$

$= 2730.065$ kJ/kg.

$W_{net} = W_T - W_P$

$\therefore W_T \Rightarrow h_1 - h_2$

$= 3117.5 - 2402.84$

$= 714.66$ kJ/kg.

$= 714.66 - 3.035$

$= 711.625$ kJ/kg

$$\eta = \frac{W_{net}}{Q_{in}} = \frac{711.625}{2730.065} = .2606 = \underline{26.06\%}$$

$$B.W.R = \frac{W_P}{W_T} = \frac{3.035}{714.66} = \underline{.00425}$$

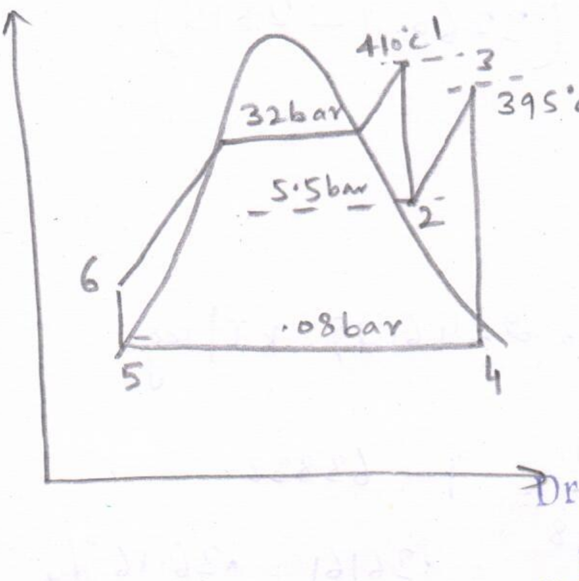
$$W.R = \frac{W_{net}}{W_T} = \frac{711.625}{714.66} = \underline{.9957}$$

$7.591 - 7.752$

7.7359

3167.15 − 3271.35

Q.6. Ans.



$P_1 = 32$ bar

$T_1 = 410°c$

$h_1 = 3251.68$ kJ/kg

$s_1 = 6.9222$ kJ/kg.K

$P_3 =$ ~~395~~ 5.5 bar

$T_3 = 395°c$ K

$h_3 = 3260.905$

$S_3 = 7.7359.$

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$s_3 = s_4 = (s_f + x\, s_{fg})_{@ .8 bar}$

$7.7359 \Rightarrow (.593 + x \times 7.637)$

$x = .935$

$h_4 \Rightarrow (h_f + x\, h_{fg})_{@ .8 bar}$

$\Rightarrow (173.9 + .935 \times 2403.2)$

$= 2420.89 \text{ kJ/kg}.$

$h_5 \Rightarrow 173.9 \text{ kJ/kg}.$

$h_2 = 2815 \text{ kJ/kg}$ (from Mollier Diagram)

$\Rightarrow W_p = .001008\,(32 - .08) \times 10^2$

$= 3.2175 = 3.22 \text{ kJ/kg}$

$h_6 = h_5 + W_p$

$= 173.9 + 3.22 = 177.12$

$Q_{in} \Rightarrow (h_1 - h_6) + (h_3 - h_2)$

$= (3251.68 - 177.12) + (3260.9 - 2815).$

$= 3519.78 \text{ kJ/kg}$

$Q_{out} = h_4 - h_5$

$= 2420.89 - 173.9 = 2246.99 \text{ kJ/kg}$

$\eta = 1 - \dfrac{Q_{out}}{Q_{in}} = 1 - \dfrac{2246.99}{3519.78} = 1 - .63838$

$= .36161 = 36.16\%$

In Pursuit of Excellence	**Class Test Papers with Solution**	SESSION-2019-2020 SEM-

Sessional Test-2

Course: B.Tech **Session: 2019-20** **Subject: Applied Thermodynamics** **Max Marks:15**	**Semester: 4rth** **Section: E** **Subject Code: KME-401** **Time: 1hour 15 Minutes**

SET-1

Ques.No.	1	2	3	4	5	6
CO	3	3	2	2/3	2	2

SECTION – A

Q.1.	List the difference between fire tube and water tube boiler.	**02**
Q.2.	Explain the working of Babcock and Wilcox Boiler OR Lancashire Boiler with neat sketch	**02**
Q.3.	Explain enthalpy of formation, enthalpy of reaction and adiabatic flame temperature.	**02**

SECTION – B

Q.4.	Explain about different types of safety valve. Explain the working of Orsat Apparatus with diagram.	**03**
Q.5.	A sample fuel has the following percentage composition by weight Carbon = 84%, Hydrogen = 10%, Oxygen = 3.5% Nitrogen = 1.5% and Ash = 1% i) Determine the stoichiometric air fuel ratio by mass ii) If 20% excess air is supplied, find the percentage composition of dry fuel gas by volume.	**03**
Q.6.	A steam power plant operates on Regenerative cycle. Steam from boiler at 30 bar and 400°C is expanded from turbine. A part of the steam is bled at 2 bar pressure in to the feed water heater and remainder is condensed at 0.07 bar. Neglecting pump work, determine the work done per kg of steam and the efficiency of the cycle.	**03**

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41.

Solution:

Q. Carbon - 84% Hydrogen - 10% Oxygen - 3.5% Nitrogen - 1.5% & Ash - 1%

A/F ratio => $\frac{100}{23}\left[\frac{8}{3}C + 8\left(H - \frac{O}{8}\right) + S\right]$

$= \frac{100}{23}\left[\frac{8}{3}\times .84 + 8\left(.1 - \frac{.035}{8}\right) + 0\right]$

$= \frac{100}{23}\left[\frac{8}{3}\times .84 + .765\right]$

$= \frac{100}{23}(2.24 + .765) = \underline{13.065}$

Actual Air Supplied :- $1.2 \times 13.065 = \underline{15.678}$

$CO_2 \longrightarrow \frac{11}{3}\times .84 = \underline{3.08}$

$O_2 \longrightarrow .23 \times (15.678 - 13.065) = .601$

$N_2 \longrightarrow .015 + .77 \times 15.678 = 12.087$

	m	M	n = m/M	%
CO_2	3.08	44	.07	13.45%
O_2	.601	32	.0188	3.612%
N_2	12.087	28	.43168	82.94%
			.52048	

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$h_4 = h_f = 163.35$

$h_5 = h_4$ → Pump work is neglected $= 163.35$

$h_6 = 504.7 = h_f$

$h_7 = 504.7 = h_6$ neglecting pump work

$$W_T = (h_1 - h_2) + (1 - m_1)(h_2 - h_3)$$

$$\Rightarrow (3231.7 - 2626.065) + (1 - .1386)(2626.065 - 2150.015)$$

$$= 1015.7045.$$

$$m_1 (h_2 - h_6) = (1 - m_1)(h_6 - h_5)$$

$$m_1 h_2 - m_1 h_6 = h_6 - h_5 - m_1 h_6 + m_1 h_5$$

$$m_1 = \frac{h_6 - h_5}{h_2 - h_5} \Rightarrow \frac{504.7 - 163.35}{2626.065 - 163.35}$$

$$= .1386$$

$$\eta \Rightarrow \frac{W_T}{Q_{in}} = \frac{1015.7045}{(3231.7 - 504.7)} = 37.25\%$$

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$\bar{h}_5 = h_4 + v\,dp$

$= 163.35 + .00100750\,(2 - .07) \times 10^2$

$\Rightarrow \underline{163.54}$

$\bar{h}_7 = h_6 + v\,dp$

$= 504.7 + (.00106)\,(30 - 2) \times 10^2$

$= \underline{507.668}$

$m_1 = \dfrac{h_6 - h_5}{h_2 - h_5} = \dfrac{504.7 - 163.54}{2626.065 - 163.54} = \underline{.13854}$

Shubham Vyas

Subject Teacher: Mr. ~~Sandeep Kr.~~

MIT Group of Institutions, Moradabad

ATTENDANCE SHEET

Session: 2019-20

Class Test I / ~~II / III~~

Date: 24/02/2020

Shift: Ist

Room No: B-311

Year: IIIrd

Semester: 4th

Section/Branch: E/ME

Subject Name: Applied thermodynamics

Subject Code: KME-401

S. No	Roll No.	Name of Student		Branch	Signature
1.	1808240001	Aarav Sanket	7	ME	Aarav Sanket
2.	1808240008	Anmol Sagar	10	ME	[signature]
3.	1808240012	Deepak Pal	9	ME	[signature]
4.	1808240010	Arpit Tyagi	4	ME	Arpit Tyagi
5.	1808240007	Aman Gahlaut	~~7~~ 6	ME	Aman Gahlaut
6.	1808240013	Deepansh Singh	10	ME	[signature]
7.	1808240014	Devish Kumar	7	ME	[signature]
8.	1808240021	Lakshay Kaushik	6	ME	Lakshay
9.	1808240027	Mohd Rahil	14.5	ME	[signature]
10.	1808240028	Muskan Bhatnagar	14.5	ME	[signature]
11.	1808240029	Nipun Vashishtha	12	ME	[signature]
12.	1808240032	Rameshwar Saran	8	ME	[signature]
13.	1808240036	Sudheer Kr. Gautam	7	ME	[signature]
14.	1808240038	Yasir Mumtaz	8.5	ME	Yasir
15.	1808210024	Anant Bansal	9	ME.	Anant
16.	1808240003	ABSENT			
17.	1808240005	ABSENT			
18	1808240011	ABSENT			
19.	~~[illegible]~~				
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

Total No. of Students allotted in Room: 18 Students Absent: ~~04~~ 03 Students present: 15

Invigilators: 1) Name Puneet Kumar Sign: [signature]

2) Name Parvesh Chandra Sign: [signature]

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44.

In Pursuit of Excellence	**Class Test Attendance** (CT -2)	SESSION-2019-2020 SEM- 4^{th}

S.No	Roll No	Name of Students	Attendance
1.	1808240001	AARAV SANKET	P
2.	1808240003	ABHINEET BHARDWAJ	P
3.	1808240004	ABHISHEK BHATNAGAR	P
4.	1808240005	ABHISHEK SINGH	P
5.	1808240006	AJAY KUMAR	P
6.	1808240007	AMAN GAHLAUT	P
7.	1808240008	ANMOL SAGAR	P
8.	1808240009	APURV CHANDEL	P
9.	1808240010	ARPIT TYAGI	P
10.	1808240011	ATIGYA GARG	P
11.	1808240012	DEEPAK PAL	P
12.	1808240013	DEEPRANSH SINGH	P
13.	1808240014	DEVISH KUMAR	P
14.	1808240015	DHARMESH DHAWAN	P
15.	1808240018	IBRAHIM KHAN	P
16.	1808240019	KARTIK CHAUDHARY	P
17.	1808240020	KRISHNA OMPRAKASH KASHYAP	P
18.	1808240021	LAKSHAY KAUSHIK	P
19.	1808240022	LOKENDRA	P
20.	1808240023	MANJUL KUMAR	P
21.	1808240025	MAYANK ANAND	P
22.	1808240027	MOHD. RAHIL	P
23.	1808240028	MUSKAN BHATNAGAR	P
24.	1808240029	NIPUN VASHISHTHA	P
25.	1808240030	PRANJAL CHAUDHARY	P
26.	1808240031	RAHUL ANAND	P
27.	1808240032	ROMESHWAR SARAN	P
28.	1808240033	SAMAN ALI	P
29.	1808240034	SAMYAK JAIN	P
30.	1808240035	SHANTANU TIWARI	P
31.	1808240036	SUDHEER KUMAR GAUTAM	P
32.	1808240037	UDAY VARSHNEY	P
33.	1808240038	YASIR MUMTAZ	P
34.	1808210024	ANANT BANSAL	P
35.	1900820409001	AMAN KUMAR	P
36.	1900820409002	ANKIT PAL	P
37.	1900820409003	MUNISH HUSSAIN SIDDIQUI	P

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45.

In Pursuit of Excellence

List of Students having short attendance

SESSION-2019-2020

SEM- 4th

Before CT – 1 (Less than 70%)

S.No	Roll No	Name of Students	H	A
1.	1808240003	ABHINEET BHARDWAJ	20	12
2.	1808240005	ABHISHEK SINGH	20	12
3.	1808240006	AJAY KUMAR	20	09
4.	1808240011	ATIGYA GARG	20	13
5.	1808240019	KARTIK CHAUDHARY	20	13
6.	1808240020	KRISHNA OMPRAKASH KASHYAP	20	11
7.	1808240021	LAKSHAY KAUSHIK	20	16
8.	1808240022	LOKENDRA	20	06
9.	1808240023	MANJUL KUMAR	20	11
10.	1808240025	MAYANK ANAND	20	11
11.	1808240030	PRANJAL CHAUDHARY	20	05
12.	1808240031	RAHUL ANAND	20	10
13.	1808240033	SAMAN ALI	20	13
14.	1808240035	SHANTANU TIWARI	20	12
15.	1808240037	UDAY VARSHNEY	20	13
16.	1808240038	YASIR MUMTAZ	20	12
17.	1900820409001	AMAN KUMAR	20	11
18.	1900820409002	ANKIT PAL	20	08
19.	1900820409003	MUNISH HUSSAIN SIDDIQUI	20	07

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Moradabad Institute of Technology

Department of Mechanical Engineering

Marks of Applied Thermodynamics (KME 401) Section - E CT - 1

S.No	Roll No.	Name of Student	CO-2	CO-2	CO-1	CO-1	CO-2	CO-2	TOTAL
			Q1.	Q2.	Q3.	Q4.	Q5.	Q6	15
1	1808240001	AARAV SANKET	1	2	1	1	1	1	7
2	1808240003	ABHINEET BHARDWAJ							
3	1808240004	ABHISHEK BHATNAGAR							A
4	1808240005	ABHISHEK SINGH							
5	1808240006	AJAY KUMAR							A
6	1808240007	AMAN GAHLAUT							
7	1808240008	ANMOL SAGAR		1	1	3		1	6
8	1808240009	APURV CHANDEL	1	2	2	1.5	3	0.5	10
9	1808240010	ARPIT TYAGI							
10	1808240011	ATIGYA GARG	0	0.5	1.5	1	1	0	4
11	1808240012	DEEPAK PAL							A
12	1808240013	DEEPRANSH SINGH	1	1	1	3	3		9
13	1808240014	DEVISH KUMAR	1.5	1.5	1	3	3		10
14	1808240015	DHARMESH DHAWAN	1.5	0.5	2	1.5	0.5	1	7
15	1808240018	IBRAHIM KHAN							
16	1808240019	KARTIK CHAUDHARY							
17	1808240020	KRISHNA OMPRAKASH KASHYAP							
18	1808240021	LAKSHAY KAUSHIK							
19	1808240022	LOKENDRA	2	1.5	1.5	1		0	6
20	1808240023	MANJUL KUMAR							
21	1808240025	MAYANK ANAND							
22	1808240027	MOHD. RAHIL							
23	1808240028	MUSKAN BHATNAGAR	2	2	2	2.5	3	3	14.5
24	1808240029	NIPUN VASHISHTHA	1.5	2	2	3	3	3	14.5
25	1808240030	PRANJAL CHAUDHARY	1.5	1.5	1.5	2	2.5	3	12
26	1808240031	RAHUL ANAND							
27	1808240032	ROMESHWAR SARAN							
28	1808240033	SAMAN ALI		1	2	1	3	1	8
29	1808240034	SAMYAK JAIN							
30	1808240035	SHANTANU TIWARI							
31	1808240036	SUDHEER KUMAR GAUTAM							
32	1808240037	UDAY VARSHNEY	0	1	2	1	3		7
33	1808240038	YASIR MUMTAZ							
34	1808210024	ANANT BANSAL	1	1.5	2	1	2	1	8.5
35	1900820409001	AMAN KUMAR	1.5	0.5	2	2	2	1	9
36	1900820409002	ANKIT PAL							
37	1900820409003	MUNISH HUSSAIN SIDDIQUI							

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Moradabad Institute of Technology

Department of Mechanical Engineering

Marks of Applied Thermodynamics (KME 401) Section - E CT - 2

S.No.	Roll No.	Name of Student	CO-3 Q1.	CO-3 Q2.	CO-2 Q3.	CO-2/3 Q4.	CO-2 Q5.	CO-2 Q6	TOTAL 15
1	1808240001	AARAV SANKET	2	2	2	2.5		3	11.5
2	1808240003	ABHINEET BHARDWAJ	1.5	2	2	1.5	2.5	3	12.5
3	1808240004	ABHISHEK BHATNAGAR	1.5	2	2	1.5	2.5	3	12.5
4	1808240005	ABHISHEK SINGH	2	2	2	2.5	2	3	13.5
5	1808240006	AJAY KUMAR	2	2	2	2.5	1.5	2.5	12.5
6	1808240007	AMAN GAHLAUT	2	2	2	3	2.5	3	14.5
7	1808240008	ANMOL SAGAR	2	2	2	2	2.5	3	13.5
8	1808240009	APURV CHANDEL	2	2	2	3	2.5	3	14.5
9	1808240010	ARPIT TYAGI	2	2	2	3	2.5	3	14.5
10	1808240011	ATIGYA GARG	2	2	2	2.5	2.5	3	14
11	1808240012	DEEPAK PAL	1.5	2	2	1.5	2.5	3	12.5
12	1808240013	DEEPRANSH SINGH	2	1.5	2	3	2.5	3	14
13	1808240014	DEVISH KUMAR	2	2	2	3	2.5	3	14.5
14	1808240015	DHARMESH DHAWAN	2	2	2	3	2.5	3	14.5
15	1808240018	IBRAHIM KHAN	2	1.5	2	1.5	2.5	3	12.5
16	1808240019	KARTIK CHAUDHARY	2	2	2	2.5	2.5	3	14
17	1808240020	KRISHNA OMPRAKASH KASHYAP	2	1	1.5	1	2.5	1	9
18	1808240021	LAKSHAY KAUSHIK	2	2	2	2.5	2.5	3	14
19	1808240022	LOKENDRA	2	2	2	1.5	2.5	1	11
20	1808240023	MANJUL KUMAR	2	1	2	1.5	1.5	3	11
21	1808240025	MAYANK ANAND	2	2	2	3	2.5	3	14.5
22	1808240027	MOHD. RAHIL	2	2	2	3	2.5	3	14.5
23	1808240028	MUSKAN BHATNAGAR	2	2	2	3	2.5	3	14.5
24	1808240029	NIPUN VASHISHTHA	2	2	2	3	2.5	3	14.5
25	1808240030	PRANJAL CHAUDHARY	2	2	2	2.5	2.5	3	14
26	1808240031	RAHUL ANAND	2		2	1.5	2.5	3	11
27	1808240032	ROMESHWAR SARAN	2	2	2	3	2.5	3	14.5
28	1808240033	SAMAN ALI	2	2	2	3	2.5	3	14.5
29	1808240034	SAMYAK JAIN	2	1.5	2	2.5	2.5	3	13.5
30	1808240035	SHANTANU TIWARI	2	2	2	1.5	2.5	3	13
31	1808240036	SUDHEER KUMAR GAUTAM	2	2	2	2	2.5	3	13.5
32	1808240037	UDAY VARSHNEY	2	2	2	2.5	2.5	3	14
33	1808240038	YASIR MUMTAZ	2	1.5	2	3	2.5	3	14
34	1808210024	ANANT BANSAL	2	1.5	2	2.5	2.5	3	13.5
35	1900820409001	AMAN KUMAR	1.5	2	2	2.5	2.5	2.5	13
36	1900820409002	ANKIT PAL	2	1.5	2	2	2.5	3	13
37	1900820409003	MUNISH HUSSAIN SIDDIQUI	2	2	2	2.5	2.5	3	14

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In Pursuit of Excellence

List of Weak Students

(Action taken for Improvement)

SESSION-2019-2020

SEM- 4th

S.No.	Roll No.	Name of Student	CT-1	CT-2
1	1808240003	Abhineet Bhardwaj	0	12.5
2	1808240006	Ajay Kumar	0	12.5
3	1808240020	Krishna Omprakash Kashyap	0	9
4	1808240022	Lokendra	0	11
5	1808240023	Manjul Kumar	0	11
6	1808240034	Samyak Jain	0	13.5
7	1808240035	Shantanu Tiwari	0	13
8	1900820409001	Aman Kumar	0	13
9	1900820409002	Ankit Pal	0	13

Action Plan for Weak students

(1) A question bank based on the previous years' question papers, is provided to the students for better preparation.

(2) Regular monitoring of their progress is done by observing their performance in lectures, tutorials and labs.

(3) Separate special classes for weak students are arranged. It helps in clarifying the doubts and re-explaining of difficult topics to such students.

(4) Important study material is provided to the weak students for better preparation.

(5) Regular counseling of weak students to enhance their habit of self learning.

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In Pursuit of Excellence	**List of Bright Students** (Action taken for enhancing performance)	SESSION-2019-2020 SEM- 4th

S.No.	Roll No.	Name of Student	CT-1	CT-2
1	1808240008	Anmol Sagar	10	13.5
2	1808240013	Deepransh Singh	10	14
3	1808240027	Mohd. Rahil	14.5	14.5
4	1808240028	Muskan Bhatnagar	14.5	14.5
5	1808240029	Nipun Vashishtha	12	14.5
6	1808240032	Romeshwar Saran	8	14.5
7	1808240038	Yasir Mumtaz	8.5	14
8	1808210024	Anant Bansal	9	13.5

Action Plan for Bright students

(1) Students are encouraged to enhance their skills by joining NPTEL/MOOC or any other special training course based on their area of interest.

(2) Questions of competitive exam level regularly taught to students.

(3) Strong monitoring of self learning activities of students.

(a) Students are encouraged to read different books and present various topics as seminar in order to enhance the presentation and communication skills.

(b) Students are encouraged to prepare their own notes of each topics.

(4) Each topic of the syllabus as well as additional topics/case studies discussed with students thoroughly.

(5) They are encouraged to participate in workshops and seminars to gain knowledge on the latest developments.

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Printed Pages:02 | Sub Code: RME403

Paper Id: 140268 | Roll No.

B. TECH.
(SEM IV) THEORY EXAMINATION 2018-19
APPLIED THERMODYNAMICS

Time: 3 Hours | ***Total Marks: 70***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a. What do you mean by air standard cycles? Discuss its' significance.

b. Define the following:
Brake power, Indicated power, Brake mean effective pressure, and Indicated mean effective pressure.

c. Enlist the requirements of a good boiler?

d. What do you mean by supersaturated flow?

e. Give limitations of Carnot vapour power cycle and explain how Rankine cycle helps in overcoming them.

f. Differentiate between impulse and reaction steam turbines.

g. Explain the significance of choked flow in a nozzle.

SECTION B

2. Attempt any *three* of the following: **7 x 3 = 21**

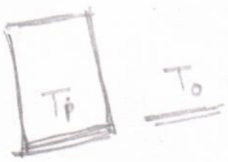
a. Derive an expression for air standard efficiency of Otto cycle in terms of compression ratio..

b. A steam engine working on Rankine cycle operates between 1.96 MPa, 250°C and 13.7 kPa. If engine consumes steam at the rate of 0.086 kg per second, determine Rankine cycle efficiency, neglecting pump work. Also, find Rankine cycle efficiency considering pump work..

c. A boiler generates 7.5 kg of steam per kg of coal burnt at a pressure of 11 bar from feed water having a temperature of 70 °C. The efficiency of boiler is 75%and factor of evaporation 1.15.Specific heat of superheated steam at constant pressure is 2.3. Calculate:
(i) Degree of superheat and temperature of steam generated
(ii) Calorific value of coal in kJ/kg
(iii)Equivalent evaporation in kg of steam per kg of coal

d. In a Parson turbine running at 1500 r.p.m., the available enthalpy drop for an expansion is 65 kJ/kg. If the mean diameter of the rotor is 100cm, find the number of rows of moving blades. Assume stage efficiency = 80%, speed ratio = 0.7, and blade outlet angle = 20°.

e. A turbo jet engine consumes air at the rate of 60.2 kg/sec when flying at a speed of 1000 km/hr Calculate, (a) the exit velocity of jet when the enthalpy change in the nozzle is 230 kJ/kg and velocity coefficient is 0.96, (b) fuel flow rate in kg/sec when air fuel ratio is 70:1, (c) thrust specific fuel consumption, (d) propulsive power, (e) propulsive efficiency, and (f) the overall efficiency.



$T_i > T_o$

$P_i < P_o$

$P_i < P_o$

$P = \rho g h$

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SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Explain Morse test in detail.

(b) Determine thermal efficiency and mean effective pressure of thermodynamic cycle used by a 4-strokepetrol engine. Details of cycle are as follows.
Compression ratio = 7
Initial state = 100 kPa and 90°C
Swept volume = 0.1 m^3
Heat added to cycle at constant volume = 100 kJ/cycle.
Consider air as working fluid

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) Describe pass out turbines and back pressure turbines

(b) A binary vapour power cycle works on mercury and steam such that dry saturated mercury vapour at4.5 bar is supplied to mercury turbine and leaves at 0.04 bar. Steam is generated as dry saturated at 15 bar and supplied to steam turbine for being expanded upto condenser pressure of 0.04 bar. Determine thermal efficiency of cycle. For mercury take,
h_f at 4.5 bar = 62.93 kJ/kg, $h_g$at 4.5 bar = 355.98 kJ/kg,
v_f at 0.04 bar = 0.0000765 m3/kg
h_f at 0.04 bar = 29.98 kJ/kg, h_g at 0.04 bar = 329.85 kJ/kg
$s_g$at 4.5 bar = 0.5397 kJ/kg.K, $s_g$at 0.04 bar = 0.6925 kJ/kg.K,
s_f at 0.04 bar = 0.0808 kJ/kg.K

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Explain the working of water level indicator, safety valves, and fusible plug, feed check valve, pressure gauge, stop valve and blow off cock.

(b) Discuss the causes of air leakage and its effect on condenser.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) A convergent divergent nozzle expands air at 6.89 bar and 427 °C into a space at 1 bar. The throat area is 650mm^2 and exit area is 975mm^2. The exit velocity is found to be 680 m/s when the inlet velocity is negligible. Assuming negligible friction. Calculate
a) Mass flow through the nozzle.
b) Nozzle efficiency and coefficient of velocity.

(b) What do you understand by compounding of steam turbines? Describe different types of compounding of steam turbines with appropriate diagram.

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) A turbojet power plant uses aviation kerosene having calorific value of 43 MJ/kg. The fuel consumption is 0.18 kg per hr per unit thrust, when thrust is 9 kN. The aircraft velocity is 500 m/s the mass of air passing through the compressor is 27 kg/s. Calculate the air fuel ratio and overall efficiency.

(b) Consider an ideal gas turbine cycle with two stages of compression and two stages of expansion. The pressure ratio for each compressor and turbine is 3.The air enters each stage of compressor at 300K and each stage of turbine at 1200K. Determine the back work ratio and thermal efficiency of cycle assuming a) no regenerator b) regenerator with 75% effectiveness.

Printed pages: 03 | Sub Code: RME 403

Paper Id: 140412 | Roll No:

B.Tech.
(SEM. IV) THEORY EXAMINATION 2017-18
APPLIED TERMODYNAMICS

Time: 3 Hours | *Total Marks: 70*

Note: 1. Attempt all Sections.

2. If require any missing data; then choose suitably.

3. Use of Steam Tables and Mollier chart is permitted.

SECTION A

1. **Attempt *all* questions in brief.** 2 x 7 = 14

a. Write the difference between the Otto cycle and Diesel cycle.

b. What is meant by cogeneration in steam power plant?

c. Enumerate the characteristics of good fuel.

d. How equivalent evaporation is used for comparison of boilers?

e. Define degree of reaction and state point locus.

f. What is enthalpy of formation?

g. Differentiate between gas turbine and I.C. engine.

SECTION B

2. **Attempt any *three* of the following:** 7 x 3 = 21

a. The following data relates to two stroke oil engine during the trial: Room temperature = 21 ℃, bore = 20 cm, stroke = 26 cm, speed = 400 rpm, brake drum diameter = 120 cm, rope diameter = 3 cm, net brake load = 460 N, indicated mean effective pressure = 2.8 bar, oil consumption 3.7 kg/h, calorific value of oil = 42000 kJ/kg of fuel, mass flow of cooling in jacket = 456 kg/h, rise in temperature of cooling water 28 ℃, temperature of exhaust gas entering in calorimeter = 320 ℃, temperature of exhaust gas leaving from calorimeter = 220 ℃, rise in temperature in calorimeter water = 8 ℃, flow rate cooling water in calorimeter is 8 kg/min. Calculate indicated power, brake power, mechanical efficiency and brake thermal efficiency. Also draw up heat balance sheet.

b. Explain the working procedure of the Orsat apparatus for flue gases determination with suitable sketch. Also determine the air fuel ratio of C_3H_8 with 150 percent theoretical air supplied.

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c. Explain the principle of working of steam impulse turbine. Why are steam turbines compounded? Explain the pressure-velocity compounding with neat diagram.

d. Calculate the mass of the flue gases flowing through chimney when the drought produced is equals to 1.9 cm of water. Temperature of the flue gas is 290℃ and the ambient temperature is 20℃. The flue gas formed per kg of fuel burnt are 23 kg. Neglect the losses and take the diameter of the chimney as 1.8 m.

e. Define the Steam Nozzle. Also derive the expressions for **velocity** of steam and **discharge** through steam nozzle.

SECTION C

3. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Derive an expressions of efficiencies of Carnot cycle and Brayton cycle with suitable assumptions.

(b) In an air standard diesel cycle with compression ratio 14, the conditions of air at the start of compression stroke are 1 bar 300K. After addition of heat at constant pressure, the temperature rises to 2775K. Determine the thermal efficiency of the cycle, net work done per kg of air and the mean effective pressure. (take: R= 287 J/kg K and γ=1.4)

4. Attempt any *one* part of the following: **7 x 1 = 7**

(a) A boiler which was originally designed to use coal as the fuel is converted into oil fired boiler. The details are: Equivalent evaporation from and at 100 ^{0}C using coal = 8.5 kg/kg of coal, Equivalent evaporation from and at 100 ^{0}C using oil = 14.5 kg/kg of oil, C.V. of oil = 42000 kJ/kg. Assuming thermal efficiency of the boiler to be same before and after conversion, find (i) Calorific Value of coal. (ii) Thermal efficiency of the boiler. (iii) Mass of oil consumed equivalent to 1000 kg of coal burnt.

(b) A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the dryness fraction, cycle efficiency, work ratio and specific steam consumption.

5. Attempt any *one* part of the following: **7 x 1 = 7**

(a) Define the blade efficiency. Derive an expression for maximum blade efficiency for an impulse turbine. $(\eta_{blade})_{max} = \text{Cos}^2\alpha$

(b) In an impulse turbine the steam issues from the nozzle with a velocity of 1200 m/s. Nozzle angle is 20° and mean blade velocity is 400 m/s. The blades are equiangular. The mass flow rate is 1000 kg/min and friction factor is 0.8. Determine: (i) Blade angles, (ii) Axial thrust, (iii) Power, (iv) Blade efficiency, (v) Stage efficiency if nozzle efficiency is 93%.

6. **Attempt any *one* part of the following:** **7 x 1 = 7**

(a) What are the essentials of a good boiler? Distinguish between Fire tube & Water tube boilers. Give two names of each. Give a neat-labeled sketch of a Babcox and wilcox Boiler.

(b) Condenser vacuum of a surface condenser is 70 cm of Hg, barometric reading is 76.5 cm of Hg, Mean condenser temperature = 35 °C, hot well temperature = 28 °C, condensate collected = 1800 kg/hr, cooling water inlet temperature = 12 °C, cooling water outlet temperature = 27 °C. Calculate: (i) vacuum efficiency, (ii) condenser efficiency.

7. **Attempt any *one* part of the following:** **7 x 1 = 7**

(a) A gas turbine plants consists of two stage compressor with perfect intercooler and a single stage turbine. If the plants work between the temperatures limits 300 K and 1000 K and 1 bar and 16 bar. Find the net power of the plant per kg of air. Take specific heat at constant pressure 1 kJ/kgK.

(b) What is the principle of jet propulsion? Classify the jet propulsion engines. Explain the working of turbo jet engines by making neat sketch.

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Printed Pages : 2 Roll No. | | | | | | | | | | | ME403

B. TECH.

THEORY EXAMINATION (SEM–IV) 2016-17

APPLIED THERMODYNAMICS

Time : 3 Hours *Max. Marks : 100*

Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION – A

1. Attempt all parts of the following questions: **10 x 2 = 20**

(a) Define adiabatic flame temperature.

(b) what do you mean by thrust augmentation.

(c) What are the sources of air leakage in condenser?

(d) How Equivalent evaporation is used for comparison of boilers?

(e) Explain about cogeneration.

(f) How regeneration in gas turbine increases thermal efficiency of the plant?

(g) Give the classification of condensers.

(h) What is saturation curve and missing quantity?

(i) Discuss type of compounding in turbines.

(j) What is ramjet?

SECTION – B

2. Attempt any five of the following questions: **5 x 10 = 50**

(a) Describe gas turbine cycle with (i) intercooling, (ii) with reheat and regeneration, (iii) with reheat and intercooling

(b) What do you mean by choked flow? Explain and write effect of friction on nozzle.

(c) (i) Draw the Hypothetical and actual indicator diagram for steam engine, write about diagram factor.

(ii) Explain saturation curve and missing quantity.

(d) A steam power plant running on Rankine cycle has steam entering HP turbine at 20 MPa, 500^0C and leaving LP turbine at 90% dryness. Considering condenser pressure of 0.005 MPa and reheating occurring up to the temperature of 500°C determine, (a) the pressure at which steam leaves HP turbine (b) the thermal efficiency

(e) With the help of a neat sketch explain Babcock & Wilcox Boiler.

(f) Boiler may have waste gases leaving the installation when artificial draught is used at 150^0C.The natural draught chimney is of 60 m height. The hot gases within chimney are at temperature of 300 $^{\circ}$C and air requirement is 19 kg per kg of fuel burnt. The atmospheric air is at 17 $^{\circ}$C temperature and mean specific heat of hot gases is 1.0032 kJ/kg $^{\circ}$ K. The calorific value of fuel burnt is 32604 kJ/kg. Determine

(i) The draught produced in mm of water

(ii) The efficiency of chimney

(iii) The extra heat carried away by flue gases per kg of fuel.

(g) One kg C8H18 fuel is supplied to an engine with 13 kg of air. Determine the percentage by Volume of CO2 in dry exhaust gas considering exhaust gas to consist of CO2, CO and N2.

(h) In a steam nozzle steam expands from 16 bar to 5 bar with initial temperature of 300^0C and mass flow of 1 kg/s. Determine the throat and exit areas considering

(i) expansion to be frictionless and,

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(ii) friction loss of 10% throughout the nozzle

SECTION – C

2 x 15 = 30

Attempt any two of the following questions:

3. Steam is the working fluid in an ideal Rankine cycle. Saturated vapor enters the turbine at 8.0 MPa and saturated liquid exits the condenser at a pressure of 0.008 MPa. The net power output of the cycle is 100 MW. Determine for the cycle (i) the thermal efficiency, (ii) the back work ratio, (iii) the mass flow rate of the steam, in kg/h

4. **(a)** Write principle of

(i) Jet Propulsion (ii) Turbojet Engine
(iii) Turboprop Engine (iv) Rocket Propulsion

(b) In a single stage simple impulse turbine the steam flows at rate of 5 kg/s. It has rotor of 1.2 m diameter running at 3000 rpm. Nozzle angle is 18°, blade speed ratio is 0.4, velocity coefficient is 0.9, outlet angle of blade is 3° less than inlet angle. Determine blade angles and power developed.

5. In a single stage impulse turbine the isentropic enthalpy drop of 200 kJ/kg occurs in the nozzle having efficiency of 96% and nozzle angle of 15°. The blade velocity coefficient is 0.96 and ratio of blade speed to steam velocity is 0.5. The steam mass flow rate is 20 kg/s and velocity of steam entering is 50 m/s. Determine

(i) The blade angles at inlet and outlet if the steam enters blades smoothly and leaves axially.
(ii) The blade efficiency
(iii) The power developed in kW
(iv) The axial thrust.

Solve using velocity diagram.

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Paper ID : 140408

B.TECH.

Theory Examination (Semester-IV) 2015-16

APPLIED THERMODYNAMICS

Time : 3 Hours ***Max. Marks : 100***

Section-A

Q1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. **(2×10=20)**

(a) Define the heat rate using in the Rankine cycle.

(b) Define propulsive power and propulsive efficiency.

(c) Explain about congeneration.

(d) Explain the significance of Willian's law in steam engines.

(e) How Equivalent evaporation is used for comparison of boilers?

(f) What do you mean by a perfect cooling?

(g) Why Rankine cycle is modified?

(h) What is clausius clapeyron equation?

(i) Define adiabatic flame temperature.

(j) What do you mean by Thrust Augmentation?

Section-B

Q2. Attempt any five question. Each question carries equal marks. (5×10=50)

(a) What do you understand by inversion curve? Define Joules coefficient. How these can be used for refrigeration?

(b) A sample fuel has the following percentage composition by weight, Carbon = 84% hydrogen = 10%. oxygen = 3.5% nitrogen = 1.5% and Ash = 1%.

(i) Determine the stoichiometric air fuel ratio by mass.

(ii) If 20% excess air is supplied, find percentage composition of dry fuel gas by volume.

(c) What is the function of condenser? Classify and Explain Barometric jet condenser with neat sketch?

(d) A steam power plant operates on the regenerative cycle. Steam form boiler at 30 bar and 400°C is expanded in a turbine. A part of the steam is bled at 2 bar pressure in to the feed water heater and the remainder is condensed at 0.07 bar. Neglecting pump work, determine the work done per kg of steam and the efficiency of the cycle.

(e) A double acting single cylinder steam engine runs at 250 rpm and evelops 30 kW. The pressure limits of operation are 10 bar and 1 bar. Cut off is 40% of the stroke. The L/D ratio is 1.25 and diagram factor is 0.75. Assume dry saturated steam at inlet, hyperbolic expansion and neglighble effect of piston rod. Find:

(i) Mean effective pressure

(ii) Cylinder dimensions

(ii) Indicated thermal

(f) An impulse steam turbine of 180 kW has steam flowing at rate of 165 kg/min and leaving axially. Steam turbine blade speed is 175 m/s and it leaves nozzle at 400 m/s. For the blade velocity coefficient of 0.9.

Find nozzle angle, blade angles at inlet and exit, axial thrust and diagram efficiency.

(g) Define critical pressure ratio for nozzle of the steam turbine. Obtain analytically its value in terms of the index of expansion.

(h) With the help of Enthalpy-entropy and schematic diagrams explain the difference between the working of a propeller turbine and a jet turbine.

Section-C

Attempt any two question. Each question carries equal marks. (2×15=30)

Q3. The following data refer to a single stage impulse turbine: Isentropic nozzle heat drop = 251 kJ/kg : nozzle efficiency = 90% : nozzle angle = 20° : ratio of blade speed to whirl component of steam speed = 0.5 : blade velocity co-efficient = 0.9 ; the velocity of steam entering the nozzle = 20m/s. Determine:

(i) The blade angles at inlet and outlet if the steam enters in to the blades without shock and leaves the blades in an axial direction.

(ii) Blade efficiency

(iii) Power developed and axial thrust in an axial direction

Q4. (a) Why are the back work ratios relatively high in gas turbine plants compared to those of steam power plants?

(b) In a gas turbine plant compression is carried out in two stages with perfect intercooling and expansion in one stae turbine. If the maximum temperature (T_{max}, K) and minmum temperature (T_{min}, K) in the cycle remain constand, show that for maximum specific output of the plant, the optimum overall pressure ratio is given by

$$r_{opt} = (\eta_T \cdot \eta_C \cdot T_{max}/T_{min})^{2\gamma/3(\gamma-1)}$$

Where γ – Adiabatic index : η_T = Isentropic efficiency of the turbine.

η_C = Isentropic efficiency of compressor.

Q5. A boiler generate 7.5 kg of steam per kg of coal burnt at a pressure of 11 bar, from feed water having a temperature of 70°C. The efficiency of boiler is 75% and factor of evaporation 1.15. specific heat of steam at constant pressure is 2.3. Calculate:

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(i) Degree of superheat and temperature of steam generated;

(ii) Calorific value of coal in kJ/kg;

(iii) Equivalent evaporation in kg of steam per kg of coal.

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Paper ID : 140407 Roll No. _ _ _ _ _ _ _ _ _ _

B.TECH.

Theory Examination (Semester-IV) 2015-16

APPLIED THERMODYNAMICS

Time : 3 Hours *Max. Marks : 100*

Note: 1. Use of steam table is permisible.

2. Assume, any missing data suitably.

Section-A

Q1. Attempt all question. **(2×10=20)**

a) Define the discharge coefficient and critical velocity of nozzle.

b) Why compounding is necessary in steam turbines?

c) Define adiabatic flame temperature and isothermal compressibility.

d) Why modified Rankine cycle is not used in steam turbines?

e) What are main requirements of a good steam boilers?

f) Make comparison between artificial over natural draught?

g) Define the stage efficiency and speed ratio of the steam turbine.

h) What is bleeding?

i) State the difference between Boiler mountings and accessories.

j) Define the term dryness fraction.

Section-B

Q2. Attempt any five. **(5×10=50)**

a) Dry saturated steam at a pressure of 6 bar flow's through nozzles at the rate of 4.5 Kg / sec and discharges at a pressure of 1.6 bar. The loss due to friction occurs only in the diverging portion of the nozzle and its magnitude is 12 % of the total isentropic enthalpy drop. Assume the isentropic index of expansion $n = 1.135$.Determine the cross sectional area at the throat and exit of the nozzles

b) What does the Clausius - Clapeyron equation signify? Derive the relation and discuss its application.

c) A boiler house has natural draught chimney of 20 mm height. Flue gases are at temperature of 380°C and ambient temperature is 27°C. Determine the draught in mm of water column for maximum discharge through chimney and also the air supplied per Kg of fuel.

d) What is purpose of governing of steam turbines? Explain the various methods used for governing of steam turbines, in brief.

e) What is basic difference between closed cycle and open cycle gas turbines? With the help of neat sketch, describe the working of a simple constant pressure open cycle gas turbine, in brief.

f) Draw the velocity diagram of a velocity compound impulse turbine. Show the calculations for finding out the tangential force, axial thrust blade efficiency and stage efficiency for both the impulse and reaction turbine.

g) A gas turbine works on Brayton cycle, gas is enters the turbine at a pressure of 600kN/m^2 and a temperature 1200K. The gas expands in the turbine isentropically (γ = 1.4) to the atmospheric pressure 100kN/m^2. Calculate

(i) Air standard efficiency of the cycle.

(ii) The temperature of the exhaust gas, if

(iii) Temperature of air at the exit end of compressor. Assume that the compression process isentropic atmospheric temperature is 300K.

h) System at 15 bar and 300°C is throttled till its pressure becomes 10 bar and then expanded isentropically passing through a turbine until pressure falls to 1 bar. The exhaust steam from the turbine is used for process work

(i) Find the condition of the steam leaving the turbine and work done per kg. of steam passing through the turbine.

(ii) If the steam is directly passed through the turbine them find the work done per kg of steam.

Section-C

Attempt any two. **(2×15=30)**

Q3. Discuss the effect of inlet pressure and temperature of steam on Rankine cycle. Write the advantages of reheating of the steam and at what pressure (in terms of initial pressure) reheating is generally done to obtain best results. Why generally one open feed water is used in Rankine cycle and what is it called?

Q4. (i) Explain the terms 'State Point locus' and 'Reheat Factor'. For six stage 1 turbine find Out the reheat factor with the help of H - S plot and prove that

(Internal efficiency = Stage efficiency x Reheat factor olThe turbine.)

(ii) For a constant pressure closed cycle gas turbine, derive the mathematical Expression of optimum pressure ratio for maximum cycle thermal efficiency.

Q5. An inventor claims to have developed an efficient hot engine which would have a heat source at 1000°C and rejects heat

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to a sink at 50°Cand gives an efficiency of 90%.Justify whether his claim is possible. Draw schematic and T-S diagrams of an open cycle gas turbine plant which has been provided with perfect intercooling, reheating and regeneration arrangements.

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PAPER ID : 140408

Roll No. | | | | | | | | | | |

B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15

APPLIED THERMODYNAMICS

Time : 3 Hours] [Total Marks : 100

1 Attempt any four parts : 5×4=20

(a) What is the difference between path function and point function, explain using p-v diagram. What is the work done in free expansion process ?

(b) Describe the steady flow energy equation for a single stream entering and leaving a control volume also explain the various terms involved. Give the differential from S.F.E.E. Also define unsteady flow process.

(c) What does the Clausius-Clapeyron equation signify ? Derive and discuss its applications.

(d) Define the following :

(i) Coefficient of volume expansion

(ii) Isothermal compressibility and

(iii) Adiabatic compressibility

(e) How regeneration in gas turbines increases thermal efficiency of the plant ?

(f) Discuss the effect of temperature on standard heat of reaction.

2 Attempt any two questions : **10×2=20**

(a) What are boilers ? How are they classified ? Differentiate between mounting and accessories.

(b) What do you understand by boiler draught ? Calculate condition for maximum discharge.

(c) Determine equivalent evaporation/kg of fuel and boiler efficiency of a boiler having steam generation at 3 mpa, 350°C at a rate of 4×10^4 kg/hr. Feed water enters economizer at 100°C and during one hour test 5×10^3 kg fuel of $Cv = 3.5\times10^4$ kj/kg is consumed.

3 Attempt any two questions : **10×2=20**

(a) Draw P-V and T-S diagram for a Rankine cycle. Derive expression for work done and efficiency of cycle. Explain how it is different from modified Rankine cycle.

(b) Dry saturated steam at pressure of 6 bar flows through converdiver nozzle at rate of 4.5 kg/sec and exit pressure as 1.6 bar loss due to friction occurs in divergent section at 12% as friction drop. Determine cross section of exit and throat area.

(c) Explain the following :

(i) Saturation curve

(ii) Indicated power

(iii) Metastable state flow through nozzle

(iv) Brake power

(v) Missing quantity

4 Attempt any two questions : **10×2=20**

(a) (i) Enumerate effect of pressure and temp. on Rankine cycle.

(ii) What is bleeding and how does it affects cycle efficiency ?

(b) Draw velocity diagram for velocity compounded turbine and find equation for maximum work done and efficiency.

(c) Define steam turbines and classify them. Explain the term compounding and its types in brief.

5 Attempt any two questions : **10×2=20**

(a) Explain in brief methods of improving efficiency of open cycle gas turbine.

(b) Explain Brayton cycle and obtain expression for efficiency in terms of pressure and temp ratio.

(c) Explain working of jet propulsion system and compare working of Ram jet with Pulse jet engines.

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EME401

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140402

Roll No. | | | | | | | | | | |

B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15

APPLIED THERMODYNAMICS

Time : 3 Hours] [Total Marks : 100

Note: (i) Attempt all questions very carefully.

(ii) All questions carry equal marks.

(iii) Use of Steam Table/Mollier chart and Calculator is allowed.

(iv) Be precise in your answer.

1 Attempt **any two** parts of the following: **10×2=20**

(a) What is the physical significance of thermodynamic relations? Prove all Maxwell relations using equations based on thermodynamics laws.

(b) Over a certain range of pressures and temperatures, the equation of state of a certain gas is prescribed by the relation

$v = (RT/p) - (C/T^3)$ where C is a constant.

Set up expressions for a change in enthalpy and entropy of the gas. Consider the change to occur under isothermal conditions.

(c) The following data pertains to the test run made in the laboratory to determine the calorific value of a gaseous fuel by Junker's gas calorimeter:

Gas burnt in the calorimeter = 10 liters

Gas temperature and pressure at inlet = 20°C and 50mm of water above atmospheric

Cooling water passing through the calorimeter = 8 liters

Inlet and outlet temperature of water = 15°C and 25°C

Steam condensed during test run = 10cc

Determine the higher and lower calorific value of fuel sample. You may take barometric pressure as 750mm of mercury and latent heat of vaporization of water as 2465KJ/kg.

2 Attempt **any two** parts of the following: **10×2=20**

(a) List the differences in between fire tube and water tube boiler. Explain working and construction of Locomotive boiler with a neat sketch.

(b) Define equivalent evaporation.

The following data are obtained in a boiler trial:

Mass and temperature of feed water: 680 kg/hr and 20°C Steam pressure and its temperature: 15 bar and 300°C

Coal used and its calorific value: 98 kg/hr and 26500 KJ/kg Flue gas formed and its temperature at chimney: 18 kg/kg of coal supplied and 300°C

Ash and unburnt coal in ash-pit: 44 kg/hr with 2200 KJ/kg calorific value

Mean specific heat of flue gases and feed water: 1 KJ/kg K and 4.187 KJ/kg K

If the ambient temperature in the boiler room is 28°C. Determine:

(i) Boiler efficiency

(ii) Equivalent evaporation from and at 100°C

(iii) Percentage heat unaccounted for

(iv) Draught produced in mm of water column if the height of chimney is 50 m.

(c) The following observations are recorded during a test on a steam condenser:

Recorded condenser vacuum = 71 cm. of Hg, Barometric reading = 76.5 cm of Hg, Mean condenser temperature = 34°C, Temperature of hot well = 28.5°C, Condensate collected = 1800 kg/hour, Flow rate of cooling water = 57500 kg/hour, Inlet temperature of cooling water = 8.5°C, Outlet temperature of cooling water = 26°C. Determine:

(i) Vacuum efficiency

(ii) Condenser efficiency

(iii) Dryness fraction of steam entering the condenser

(iv) Mass of air leakage per m^3 of the condenser volume.

3 Attempt **any two** parts of the following: **10×2=20**

(a) A steam engine of 30 cm diameter and 50 cm stroke length is supplied steam at 10 bar and 300°C. The steam expands adiabatically to 0.7 bar and then release occurs at constant volume to a condenser at 0.3 bar. Represent the cycle on P-V and T-S plots and compare it with the corresponding diagram for the complete Rankine cycle. Determine:

(i) The modified Rankine cycle efficiency

(ii) The Rankine efficiency corresponding to complete expansion.

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(b) A supersonic nozzle is to be designed for air flow with Mach number 3 at the exit section which is 250 mm in diameter. The pressure and temperature of air at the nozzle exit are 8.5 kN/m^2 and 215 K. Make calculations for:

(a) Reservoir pressure and temperature

(b) Throat area.

(c) Prove expression for mass flow rate per unit area of steam in a nozzle. Also give condition for maximum discharge.

4 Attempt **any two** parts of the following: **10×2=20**

(a) (i) What are effects of pressure and temperature on Rankine cycle efficiency and output? Explain showing in cycle.

(ii) Compare impulse and reaction turbine.

(b) In a regenerative feed heating cycle, the steam enters the turbine at 25 bar and 250°C. The condenser pressure is 0.05 bar. The steam is bled off for feed water heating for a closed heater at 3.5 bar and for an open heater at 0.7 bar. The condensate of the closed heater is discharged into the low pressure open heater. Calculate the thermal efficiency of the cycle. Neglect the pump work. Also determine the corresponding Rankine cycle efficiency.

(c) In a Parson's reaction turbine the rotor of 1 m diameter runs at 3000 rpm. Determine the isentropic enthalpy drop in the stage considering stage efficiency of 0.80, ratio of linear velocity of blade to absolute velocity at inlet of moving blade=0.7, blade outlet angle = 20°.

5 Attempt **any two** parts of the following: 10×2=20

(a) Classify Gas turbines. Explain the cycle on which Gas turbine works? Also, explain it with reheat and regeneration showing its effects when used simultaneously in a single cycle.

(b) Air enters the compressor of a gas turbine plant operating on Brayton cycle at 1 bar pressure and 300 K temperature. The pressure ratio is 5 and the maximum cycle temperature is limited to 1075 K. If the compressor and turbine efficiencies are 80% and 85% respectively. Make calculations for the net work output, cycle efficiency and the work ratio.

(c) Compare Jet engine and Propeller engine. Explain working and construction of turbojet engine.
