Swami Keshvanand Institute of Technology,
Management & Gramothan

Approved by AICTE, Ministry of HRD, Government of India
Recognized by UGC under Section 2(f) of the UGC Act, 1956
Affiliated to Rajasthan Technical University, Kota

Affiliating University Notice regarding Feedback/ Suggestion Submission

: RAMNAGARIA (JAGATPURA), JAIPUR-302017 (RAJASTHAN), INDIA
: +91-141-5160400, 2752165, 2759609 | : 0141-2759555
: info@skit.ac.in | : www.skit.ac.in

OFFICE OF THE DEAN ACADEMIC AFFAIRS
RAJASTHAN TECHNICAL UNIVERSITY

AKELGARH, RAWATBHATA ROAD, KOTA
Ph-0744-2473015, Fax-0744-2473857
Website : www.rtu.ac.in Email: rtu.dir.acad@gmail.com

RTU/Acad./F(17)04/17/16243 Date: 09.03.2017 10.

To
The Principal/Director
All RTU Affiliation College

Sub: Feedback/suggestions for the updation of the existing curriculum of University B.Tech. Courses.

Sir/Madam

Rajasthan Technical University, Kota is going to update its existing curriculum (scheme & syllabus) from 2017-18 for the running B.Tech. course(s). A google form is available on link https://goo.gl/forms/qi77ICNxLsuiVyj03 Any Faculty/Resource Person/Students/Stakeholders can submit their suggestions.

You are requested to paste the above goggle form link on your institute's website for its wide publicity and good response.

This may kindly be taken on top priority and the suggestions are welcome latest by 24.03.2017.

Yours sincererly

Dean, Academic Affairs

Swami Keshvanand Institute of Technology, Management & Gramothan
Ramnagaria (Jagatpura) Jaipur-17

SKIT/2017/ 677 Date: March 21, 2017

NOTICE

(Urgent &Important)

It is to notify students, faculty members and HODs of all departments that RTU, Kota has sought feedback/suggestions for the updation of the existing curriculum of University for B.Tech. Courses. Regardig this copy of e-mail as received from RTU has already been sent to all HODs.

In this regard, HODs are requested to go through the details of scheme and syllabus of their respective branches. They may prepare a draft including valuable information given by any of the stakeholders and may discuss the final draft/points with undersigned latest by March 23, 2017. The same may be submitted online at the following goggle form link (as given below/through our institute portal). Also, if any stakeholder is desirous to give his/her suggestions directly, he/she may visit the following link and submit the required feedback.

https://goo.gl/forms/qi77ICNxLsuiVyj03

This may kindly be taken on top priority as the suggestions are to be filled latest by 24.03.2017.

S. L. Surana
(Dr. S. L. Surana)
Director Academics

Copy to:

1. The Director
2. The Director (D&W)
3. The Principal
4. The Registrar
5. The Advisers
6. All the HODs-EC, EE, CS, IT, ME, CE, DMS, I/c B. Tech. 1st year, Physics, Chemistry, Maths, English, Humanties, TPC
7. Dy. Registrar/ Examination Cell/ Website Admin
8. Notice Boards
9. All the faculty Members by circulation
10. File

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Blank Feedback Form

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RAJASTHAN TECHNICAL UNIVERSITY KOTA CURRICULUM REVISION OF B. TECH. COURSES (FEEDBACK/SUGGESTION FORM)

ankitsagarwal@gmail.com Switch accounts

*Required

Email *

Your email address

NAME *

Your answer

DESIGNATION *

Your answer

NAME OF INSTITUTE/ INDUSTRY/ ORGANISATION *

Your answer

Contact No.

Your answer

ADDRESS FOR COMMUNICATION *

Your answer

PLEASE INDICATE YOUR CATEGORY *

- ○ Principal/ Director
- ○ Faculty
- ○ Industrialist/ Professional
- ○ Research Scientist
- ○ Alumni
- ○ Present student
- ○ Other: ______

Next

Clear form

RAJASTHAN TECHNICAL UNIVERSITY KOTA CURRICULUM REVISION OF B. TECH. COURSES (FEEDBACK/SUGGESTION FORM)

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*Required

Faculty *

- Professor
- Associate Professor
- Assistant Professor

Back Next Clear form

BRANCH OF ENGINEERING FOR WHICH FEEDBACK/ SUGGESTIONS TO BE MADE (CLICK ON THE LINK TO SEE SCHEME AND SYLLABUS BEING TAUGHT PRESENTLY) *

http://www.rtu.ac.in/RTU/b-tech-2012-13

- I year (common for all branches)
- Mechatronic Engineering
- Professional Ethics and Disaster Management
- Aeronautical Engineering
- Applied Electronics & Instrumentation
- Automobile Engineering
- B.Architecture
- Agricultural Engineering
- Bio Technology
- Bio Medical Engineering
- Ceramic Engineering
- Chemical Engineering
- Civil Engineering
- Computer Science
- Electronics & Communication Engineering
- EIC Engineering
- Electrical Engg.
- Electrical & Electronics Engg.
- Industrial Engineering
- Information Technology
- Mechanical Engineering
- Mining Engineering
- Petroleum Engineering
- Petrochemical Engineering
- Production and Industrial Engineering
- Textile Chemistry
- Textile Technology
- Textile Engineering
- Food Technology

RAJASTHAN TECHNICAL UNIVERSITY KOTA CURRICULUM REVISION OF B. TECH. COURSES (FEEDBACK/SUGGESTION FORM)

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Draft saved

*Required

Suggestion for removal of subject Please go through the scheme and syllabus and mention the subject(s) to be removed in a particular semester with justification(Write the subject code as per the scheme to be removed)

http://www.rtu.ac.in/RTU/b-tech-2012-13

Semester in which you want to remove a subject

3 sem

Write the subject(s) code(s) to be removed

Your answer

Give your justification

Your answer

Do you want to submit more suggestions for removal of more subjects. *

- Yes
- No.

Back

Next

Clear form

RAJASTHAN TECHNICAL UNIVERSITY KOTA CURRICULUM REVISION OF B. TECH. COURSES (FEEDBACK/SUGGESTION FORM)

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*Required

Suggestion for removal of subject Please go through the scheme and syllabus and mention the subject(s) to be removed in a particular semester with justification(Write the subject code as per the scheme to be removed)

Semester in which you want to remove a subject

Choose

Write the subject(s) code(s) to be removed

Your answer

Give your justification

Your answer

Do you want to submit more suggestions for removal of more subjects. *

- Yes
- No

Back Next Clear form

RAJASTHAN TECHNICAL UNIVERSITY KOTA CURRICULUM REVISION OF B. TECH. COURSES (FEEDBACK/SUGGESTION FORM)

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*Required

Suggestion for removal of subject Please go through the scheme and syllabus and mention the subject(s) to be removed in a particular semester with justification(Write the subject code as per the scheme to be removed)

Semester in which you want to remove a subject

Choose

Write the subject(s) code(s) to be removed

Your answer

Give your justification

Your answer

*

- Proceed further for suggesting ADD/Modify
- Proceed further without suggesting ADD/Modify

Back Next Clear form

RAJASTHAN TECHNICAL UNIVERSITY KOTA CURRICULUM REVISION OF B. TECH. COURSES (FEEDBACK/SUGGESTION FORM)

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*Required

In the present scheme, each theory paper has 80% component of University and term examination and 20% component is of mid-term examination. In your opinion, the composition should be- *

- ○ 100-0
- ○ 90-10
- ○ 70-30
- ○ No Change

The present question paper pattern in examination has five units with internal choice in each unit. In your opinion, the pattern of question paper in examination may be changed as *

- ○ Questions in first part (short questions) be compulsory covering complete syllabus with no choice. In second part (long questions) be compulsory covering covering complete syllabus with 10% choice. In third part (very long questions) be compulsory covering complete syllabus with 25% choice.
- ○ Questions in first part (short questions) be compulsory covering complete syllabus with 20% choice. In second part (long questions) be compulsory covering covering complete syllabus with 20% choice. In third part (very long questions) be compulsory covering complete syllabus with 30% choice.

In your opinion, the module of 'Human Values and Professional Ethics' should be in the form of *

- ○ Only one theory course
- ○ Only one sessional course
- ○ One theory and one sessional course

Suggest the scope of SEMINAR to make it more effective in existing curriculum. Please give your suggestion with justification. (Presently students select a topic and give presentation in SEMINAR) *

Your answer

In your opinion, how SKILL DEVELOPMENT COURSES or SOFT COMPUTING COURSES may be included in the existing curriculum for better employability of the students? Please give your suggestions with justification. *

Your answer

The mode of PRACTICAL TRAINING should be in the form of *

- ◯ 60 days industrial training once after 6th semester i.e. present system
- ◯ 45 days industrial training twice after 4th and 6th semester
- ◯ One complete semester Industrial training

Suggest the methodology to be adopted to fulfill the objectives of 'Project Work' in the present curriculum? Give your suggestions with justification. How entrepreneurship can be inducted through project work in students? *

Your answer

Should 'Check Point' system be strictly implemented in University? Presently there is no check point system in the University. (In 'Check Point' system students will be promoted to 3rd year if 1st and 2nd Semesters are cleared and similarly will be promoted to final year if 3rd and 4th semesters are cleared) *

- ◯ Yes
- ◯ No

Back Submit Clear form

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Suggestion Forward to Affiliating University

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Affiliated to Rajasthan Technical University, Kota

SKIT/2018/57

Date: 07.8.2018

To

The Vice Chancellor,
Rajasthan Technical University,
Rawatbhata Road, Akelgarh,
Kota-324010

Ref: Request to include SCILAB software as an alternative to MATLAB in the syllabus of RTU course 3ME4-24-programmimg using MATLAB

Dear Sir,

I am forwarding the request received from our department of Mechanical Engineering about the recently introduced course 3ME4-24-programming using MATLAB. I may draw your kind attention towards the policy of apex educational bodies like AICTE and UGC that the use of open source softwares should be promoted rather than commercial softwares. SCILAB software is an open source software which is equivalent to MATLAB software in every respect.

It is therefore suggested that SCILAB software be included in the syllabus as an alternative to MATLAB software. It will also be in the interest of the students because they can also practice on this software at home.

An early action in this regard will be highly appreciated.

With kind regards

PRINCIPAL
Swami Keshvanand Institute of Technology, Management & Gramothan
Ramnagaria, Jagatpura, JAIPUR-25

S. L. Surana
DR.S.L.SURANA
Director (Academics)
SKIT, JAIPUR

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Date: 30/07/2018

Dr. N.C. Bhandari,
Professor and Head,
Department of Mechanical Engineering,
Swami Keshvanand Institute of Technology, Management & Gramothan,
Jaipur - 302017

Subject: ***Request to send representation to RTU for change in the syllabus of lab course: "Programming using MATLAB (3ME4-24)"***

Dear Sir,

In the recent update of syllabus by RTU for 3rd semester Mechanical Engineering, a new lab course: "***Programming using MATLAB***" (*course code: 3ME4-24*) was introduced. I am attaching the syllabus of this course for your reference. As can be seen from the syllabus, the installation of the commercial software MATLAB in our computer lab becomes necessary in order to teach the course. In turn, for the students to practice at home after classes, it again becomes necessary for them to own licensed copies of the software (which is quite expensive).

Now I would like to draw your attention to the fact that back in 2013, AICTE had announced a list of free open source software equivalent to various commercial packages. I am attaching this list too for your perusal. You can see that the first suggestion in the list is SCILAB (free open source software) against MATLAB. Personally, after comparison of SCILAB and MATLAB, I have found these to be very similar; and I strongly feel that the syllabus of this lab course can be more than satisfactorily taught using SCILAB instead of MATLAB.

With all due respect to RTU, I would like to comment that contrary to the efforts of AICTE to provide low cost and high quality education to our students; this recent update of syllabus by RTU seems like an advertisement of the commercial software MATLAB. Therefore, keeping in mind the best interest of our students, I humbly request you to send a representation to concerned authority at RTU to at least re-design the syllabus of this course to be inclusive of SCILAB as an alternative to MATLAB.

Thanking you,

Yours Sincerely,

Dr. Manu Augustine
(Associate Professor)
Department of Mechanical Engineering,
SKIT-Jaipur

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Ramnagaria, Jagatpura, JAIPUR-25

Commercial Software	Similar Open source	Download Link	License	Used where
MATLAB	Scilab	http://www.scilab.org/products/scilab/download	CeCILL	Engineering (Electrical, Mechanical, Civil, Electronics, Embedded systems, Chemical), Science (Physics, Mathematics)
Mathematica	Maxima	http://maxima.sourceforge.net/download.html	GPL	Mathematics, Engineering
Cadence pSpice	ngspice	http://ngspice.sourceforge.net/download.html	BSD	Engineering (Electrical, Electronics, Embedded systems)
Microsoft Office	Open office	http://download.openoffice.org/	LGPL	All branches
Microsoft Office	LaTeX	http://www.latex-project.org/ftp.html	LPPL	All branches
Mathematica/Maple	Sage	http://www.sagemath.org/download.html	GPL	Precise arithmetic, algebra, symbolic computation
Microsoft Windows	GNU/Linux	http://www.gnu.org/software/software.html	GPL	All branches
Turbo C	GCC	http://gcc.gnu.org/releases.html	GPL	Engineering (Introductory Computing – all branches)
Pro/E	BRL-CAD	http://brlcad.org/d/download	BSD	Engineering (CAD)

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MASM	NASM, FASM	http://www.nasm.us/pub/nasm/releasebuilds http://flatassembler.net/download.php	BSD, BSD	Engineering (Electronics, Computer Science)
MS OFFICE Plotting tools	Xmgrace, XFIG, GNUPLOT	http://sourceforge.net/projects/graceplot/ http://xfig.org/art17.html http://www.gnuplot.info/download.html	BSD, GPL, Own license (but free)	Drawing the figures, plots, flow diagrams
Code composer Studio, IAR Workbench	GNU Binutils	http://ftp.gnu.org/gnu/binutils/	GPL	Assembler, Compilers for micro controllers and DSP Processors (MSP, VC33 etc)
VxWORKS	RTLinux, RTAI	http://www.faqs.org/docs/Linux-HOWTO/RTLinux-HOWTO.html https://www.rtai.org/	GPL, GPL/LGPL (kernel and user space respectively),	Real-time operating System for Desktop and Embedded Systems
KEIL 8051	SDCC	http://sdcc.sourceforge.net/index.php#Download	GPL	GCC SDCC compiler for 8051 controlers
synopsis-CosmosSE, Mentor-Icstudio, Cadence-Virtuoso	Xcircuit	http://opencircuitdesign.com/xcircuit/download.html	GPL	schematic design
Mentor-ICstation, Cadence-Virtuoso	Magic	http://opencircuitdesign.com/magic/download.html	BSD	Used for chip Layout design
Modelsim	ghdl, freehdl	http://ghdl.free.fr/download.html http://freehdl.seul.org/	GPL	VHDL compiler
Matlab	Octave	http://www.gnu.org/software/octave/download.html	GPL	Numerical Computation
AutoCad	KiCad,	http://kicad.sourceforge.net/wiki/Downloads	GPL	CAD system

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Ramnagaria, Jagatpura, JAIPUR-25

Ref. SKIT/ME/2016//7 Date: - 25.10.2016

Dr. N.K. Banthiya

Professor & Head of the Department of Mechanical Engineering

The Controller of Examination,
Rajasthan Technical University,
Rawatbhata Road
Kota-3240 10

Subject: - Comments about 3ME3A Engineering Thermodynamics Paper for B.Tech. III Semester (Main/Back) Examination of January 2016

Dear Sir,

There were a large number of failures in this paper in our Institute and possibly this must have happened in other institutes also. I am writing to you to draw your kind attention about the question paper set last year, so that similar situation is not repeated this year.

1. My attention has been drawn to the fact that almost full paper has been set from one book; descriptive as well as numerical questions have been word to word taken from this book. The book is Thermodynamics by Prasanna Kumar, Pearson Chennai * Delhi (2013).

   Following enclosures are being enclosed with this letter for ready reference:

   Enclosure I- University Syllabus for 3ME3A: Engineering Thermodynamics

   Enclosure II- University Question Paper 3E1633 B.Tech. III Sem Jan.2016

   Enclosure III- Details of questions from the book Thermodynamics by Prasanna Kumar, Pearson Chennai * Delhi (2013).

   Enclosure IV- Photocopies of pages from the book Thermodynamics by Prasanna Kumar, Pearson Chennai * Delhi (2013).

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2. Using a single book for setting a question paper seems unfair to me. The book used is neither prescribed text book nor a reference book. Prescribed text book is Engineering Thermodynamics by P.K. Nag (Tata McGraw-Hill).
3. There are some portions of questions in this paper which are out of course for the students or which use terminology which are not used in the Text book prescribed and other reference books. These are:

(a) Q. 3 (b) Characteristic functions is the terminology used in book by Prassana Kumar. This terminology does not exist in the Text book.
This part of the question, in my opinion is out of course.

(b) Q. 4 (b) Question is about a number of cycles, including Atkinson cycle. This cycle is not mentioned in the syllabus, and is out of course. It is not there in the prescribed Text book.

4. Alternative Question 1 (a) is wrong. In the question, work done has been written as 53 kN, kN is the unit of force not work. Question is from the book by Prassana Kumar, but there work done has been written as 53 kW, which is correct.
5. Important data necessary for solving numerical problems are missing from some questions. In Q. 1 (b), where air is the working substance Cp ,Cv and R values have been given. Also in alternative Q. 3 (b), where working substance is an unspecified ideal gas Cp and Cv values have been given. However, in alternative Q. 1 (a), where a hydrocarbon gaseous fuel is the working substance and in alternative question 2 (a), where nitrogen is the working substance, these values have not been given. This has possibly happened because these questions have been picked up from the book without realizing that in the book these values can be obtained from the tables.
6. Some specific comments about a few questions are also necessary.
   (a) Q 1(a) (iii) asks for drawing a number of process diagrams for various processes. No working substance has been specified in the question. Assuming that an ideal gas is the working substance, these can be drawn. Question asks (5 x 4) diagrams for 4 marks. What kind of marking scheme would have been devised for evaluating this question, and is it possible for III semester students to even attempt such a question. Students are normally familiar with p-v coordinates. For drawing each diagram, functional dependency will have to be determined. It will take a fairly long time to do this question.

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Ramnagaria Jagatpura, JAIPUR-25

(b) Q.1 (b) is a solved example from the book by Prassanna Kumar. Solution assumes 'reversible adiabatic' process during discharge process, which cannot be justified. Process is throttling during discharge which cannot be considered as 'reversible'. If this kind of assumption is envisaged, it needs to be stated in the question. Assumption of 'reversible adiabatic' or 'isentropic' also pre-supposes that Unit II has been covered. Also ideal gas and isentropic process for ideal gas is the subject matter of Unit III.

(c) In alternative question Q.2 (b) (i) Carnot cycle is required to be drawn on five sets of coordinate systems for 4 marks; some of the coordinate systems are usually not considered in classes and books. To do that will require a lot of effort and thinking on the part of the students. Also Carnot cycle for an ideal gas can be drawn only after study of Unit III on ideal gases.

7. Although it is written on the question paper that questions are set Unit-wise, it is not so.
   (a) In Q.1 (a) 'Joule-Thomson coefficient' has been asked, It is not a part of Unit I. It is part of Unit IV, as can be seen in the syllabus.
   (b) Q. 1 (b), alternative question Q.1 (a) and alternative question Q.2 (a) has ideal gases as the working substance, which is subject matter of Unit III.
   (c) Q. 3 (a) relates to isothermal compressibility which is part of Unit IV-Thermodynamic relations.
   (d) Similar situation is there in other questions also.

I hope that you will look into the matter, and as requested earlier see that similar situation does not arise this year again.

It is requested that whenever a paper is set, model answers are also obtained from the examiners and supplied to the examiners during paper checking. Sending model answers will also result in time estimate by paper setters. Also, if model answers are posted on university website, it will improve teaching-learning in the institutions.

Thanking you,

Yours faithfully

N.Banthiya

(N.K. Banthiya)

Head, Mechanical Engineering
Swami Keshvanand Institute of Technology
Management & Gramothan, Ramnagaria, Jagatpura, JAIPUR

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Technology, Management & Gramothan
Ramnagaria Jagatpura, JAIPUR-25

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Approved by AICTE, Ministry of HRD, Government of India and
Affiliated to Rajasthan Technical University, Kota

Ref. SKIT/ME/2016/ /8

Date: - 25.10.2016

Prof. Anil. K. Mathur

Dean, Faculty of Engineering & Architecture

Rajasthan Technical University,
Rawatbhata Road,
Kota-3240 10

Subject: - Comments about 3ME3A Engineering Thermodynamics Paper for B.Tech. III Semester (Main/Back) Examination of January 2016

Dear Prof. Mathur,

This is in context of my discussion with you during your visit to SKIT, Jaipur.

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1. My attention has been drawn to the fact that almost full paper has been set from one book; descriptive as well as numerical questions have been word to word taken from this book. The book is Thermodynamics by Prasanna Kumar, Pearson Chennai * Delhi (2013).

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RAMNAGARIA (JAGATPURA), JAIPUR-302017 (Raj.) India
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   (a) In Q.1 (a) 'Joule-Thomson coefficient' has been asked, It is not a part of Unit I. It is part of Unit IV, as can be seen in the syllabus.
   (b) Q. 1 (b), alternative question Q.1 (a) and alternative question Q.2 (a) has ideal gases as the working substance, which is subject matter of Unit III.
   (c) Q. 3 (a) relates to isothermal compressibility which is part of Unit IV-Thermodynamic relations.
   (d) Similar situation is there in other questions also.

I hope that you will look into the matter, and as requested earlier see that similar situation does not arise this year again.

It is requested that whenever a paper is set, model answers are also obtained from the examiners and supplied to the examiners during paper checking. Sending model answers will also result in time estimate by paper setters. Also, if model answers are posted on university website, it will improve teaching-learning in the institutions.

Thanking you,

Yours Sincerely

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ENC|-1

3ME3A: ENGINEERING THERMODYNAMICS

B.Tech. (Mechanical) 3rd semester | **Max. Marks: 100**
3L+1T | **Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
I	**Basic Concepts and definitions of Thermodynamics**: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	2
	Zeroth and First Law of Thermodynamics: Zeroth of Thermodynamics, Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	5
II	**Second Law of Thermodynamics:** Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Plank and Clausius statements. Reversible and Irreversible Processes, Carnot engine, Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausis Inequality.	4
	Entropy: Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume.	3
	Availability: Available energy, Loss in available energy, Availability Function, Irreversibility.	3
III	**Thermodynamic Properties of Fluids:** Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart	4
	Ideal Gas and Real Gas: Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures.	4
IV	**Thermodynamic Relations:** Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation.	4
	Power Cycles: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and Ericsson cycle.	5
V	Vapour power cycle: Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle	3
	Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	3
	TOTAL	40

TEXT BOOK		
1	Nag P.K., Engineering Thermodynamics, Tata Mc-Graw Hill	
REFERENCE BOOKS		
SN	**Name of Authors /Books /Publisher**	**Year of Pub.**
1	Chattopadhyay P., Engineering Thermodynamics, Oxford University Press.	2011
2	Van G.J. Wylen and Sonntag R.E., Fundamental of Thermodynamics,	2003

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3E1633

Roll No. ______________ Total No of Pages: 4

3E1633

B. Tech III Sem. (Main/Back) Exam. Jan. 2016

Mechanical

3ME3A Engineering Thermodynamics

Common to 3AN3, 3PI3A and 3AE3A

Time: 3 Hours **Maximum Marks: 80**

Min. Passing Marks: 26

Instructions to Candidates:

*Attempt any **five questions,** selecting **one question** from **each unit.** All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.

1. Steam Table 2. Molier chart

UNIT-I

Q.1 (a) (i) What is the perpetual motion m/c of the first kind? [2]

(ii) What is Joule – Thomson coefficient? Explain its significance. [2]

(iii) Sketch the following process on p – v, p – T, v – T, u – T and h – T coordinates – isochoric, isothermal, isentropic & isobaric. [4]

(b) A tank $1 m^3$ in volume is filled with air at an absolute pressure of 700kPa and a temperature of 120°C. The air is discharged to the atmosphere through a valve. Consider air to be a perfect gas.

Take R = 0.287kJ/kgK, C_P = 1.169 kJ/kgK and C_V = 0.717kJ/kgK.

What would be the work that is lost in the kinetic energy of air? [8]

(b) (i) Sketch T-S, p - v, p - h, h - s & h - v diagrams of a Carnot cycle using ideal gas as a working fluid. [4]

(ii) Prove that for a steady flow isothermal process, the difference in Gibbs function represents the maximum work. [4]

UNIT-III

Q.3 (a) Determine the isothermal compressibility of an ideal gas and a vander waals gas. [8]

(b) What are characteristic functions? Prove that the internal energy of an ideal gas is function of temperature only. [8]

OR

Q.3 (a) Derive an expression for the change in enthalpy of a gas follows the equation of state $p(v - b) = RT$. [8]

(b) A vessel with a volume of 0.1 m^3 contains an ideal gas at 100°C, 600 kPa. It expands isentropically to a final pressure of 150 kPa. Evaluate the work done. Assume $C_v = 0.7202$ kJ/kgK and $C_p = 1.0044$ kJ/kgK. [8]

UNIT-IV

Q.4 (a) Derive an expression for the air standard efficiency of a Otto cycles. [8]

(b) Explain with p – v & T-S diagram-

Atkinson cycle, Ericssion cycle, stirling cycle & Dual cycle. [8]

Enclosure III: Details of questions from the book Thermodynamics by Prasanna Kumar, Pearson Chennai * Delhi (2013).

Units as given in Question paper	Question No. in Question Paper 3ME3A Engineering Thermodynamics Jan.2016 paper	References in the book Thermodynamics by Prasanna Kumar, Pearson Chennai * Delhi (2013).
I	Q.1 (a) (i)	Review Question 9 (i)- Page 79
	(ii)	Review Question 10 - Page 102
	(iii)	Problems 12- Page 79
	(b)	(Solved) Example 5.8- Page 100
	OR	
	Q.1 (a)	Problem 2- Page 102
	(b)	Problem 5- Page 102
2	(a) (i)	Review Question 18 (only first part)- Page130
	(ii)	Review Question 12 - Page130
	(iii)	Review Question 16 - Page130
	(b)	Problem 12- Page 131
	OR	
Q.2	(a)	(Solved) Example 7.9-Page 149
	(b) (i)	Review Question 18 - Page156
	(ii)	Review Question 7 – Page 176
3	(a)	Problem 2- Page 199
	(b)	Review Questions 2 & 4- Page 198
	OR	
	Q.3 (a)	Review Question 9: Page 199
	(c)	(solved) Example 11.2: Page 231
Unit IV	Q.4 (a)	-
	(b)	Slight change Review Question 9 : Page 360 (Atkinson cycle is not there in this question)
	OR	
	Q.4 (a)	-
	(b)	-
Unit V	Q.5 (a)	(Solved) Problem Example 15.1: pages 308 & 309
	(b)	-
	OR	
	Q.5 (a)	-
	(b)	-

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ENCI → II

8. What is perpetual motion machine of the first kind? Q1 (a) (i)
9. What is enthalpy?

Problems

1. In a constant internal energy process, 50 J of heat is added to a system. What is the work delivered by the system?
2. In a process undergone by a system, 60 J of heat is added to the system while it performs 40 J of work. What is the change in energy of the system?
3. A system takes in 75 J of heat while delivering 35 J of work to the surroundings. It then returns to its initial state when the surroundings perform 25 J on the system. Make an energy balance and identify all the heat and work interactions. Will there be a change in total energy of the system after completion of both the processes?
4. One kilogram of an ideal gas at 400 K expands polytropically in a cylinder until the temperature is 300 K. The final volume is 3 m^3. Determine the value of n. Use tables where required.
5. A gas enclosed in a cylinder fitted with a piston has an initial total energy of 100 kJ. Twenty-five kilojoules of heat is added to the system. The system delivers 40 kJ of work. The mass of gas in the system is 0.8 kg. Determine the final total energy of the system.
6. Two brass cylinders at different temperatures are placed together in an insulated container. One of the cylinder loses 150 kJ of energy while the surrounding air gains 15 kJ. What would be the energy change in the second brass cylinder?
7. 2 kilograms of propane is heated in a closed vessel at a constant pressure of 180 kPa. The temperature change during the process is from 20°C to 80°C. If the work delivered is 25 kJ, determine the heat added to the gas.
8. A 70-kg labourer has a potential energy of –2,400 kJ while working below ground level. He has to climb to the top of a building where his potential energy will be 3,200 kJ. If the local gravitational acceleration is 9.81 m/s^2, what is the total height he has to climb?
9. Butane is compressed isothermally in a closed vessel from 100 to 200 kPa. At the beginning of the process, the butane density is determined to be 0.98 kg/m^3 and the volume is 0.038 m^3. During the compression, 3.50 kJ of heat is removed from the butane. What is the change in internal energy of butane?
10. Derive an expression involving the modulus of elasticity for the change in stored energy of a wire that is stretched without any heat transfer.
11. Water at 25°C and ice at –3°C are mixed in equal proportions. What will be the resulting temperature?
12. Sketch the following processes on p–V, p–T, v–T, u–T and h–T coordinates: Q.1 (a) (iii)
    (a) isochoric,
    (b) isothermal,
    (c) isentropic and
    (d) isobaric.
13. A closed vessel contains nitrogen at pressure and temperature higher than the surroundings. A valve in the vessel is opened until the nitrogen reaches the conditions of the surroundings. Derive an expression relating the mass of nitrogen leaked out to the initial and final conditions.
14. How much heat has to be added to 1.5 kg of air in a closed container, at a pressure of 110 kPa, to change its temperature from 25°C to 125°C without altering its pressure?
15. In an adiabatic compression of 30°C air in a cylinder, the pressure increases from 110 to 250 kPa. Find the internal energy and enthalpy changes per unit mass of air.

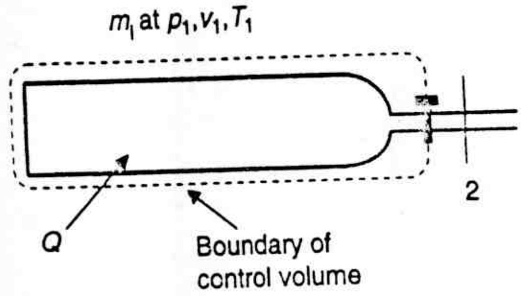

Fig. 5.18 Control volume analysis of tank discharge

5.6.7 Control Volume Analysis

Let the tank be chosen as the control volume as shown in Fig. 5.18. The initial energy stored in the tank is

$$E_i = m_i u_i.$$

The energy stored in the tank after discharge is

$$E_f = m_f u_f.$$

The energy leaving the tank is

$$(m_i - m_f)(h_2 + v_2^2/2).$$

The energy entering the tank is Q. Now, according to control volume analysis, the energy γ leaving the tank minus the energy entering the tank must equal the decrease in the stored energy of the tank. Hence

$$(m_i - m_f)(h_2 + v_2^2/2) - Q = m_i u_i - m_f u_f \tag{5.53}$$

or

$$Q = m_f u_f - m_i u_i + (m_i - m_f)(h_2 + v_2^2/2) \tag{5.54}$$

which is the same as Eq. (5.50). In many respects, the control volume analysis is shorter and easier to apply than control mass analysis.

Example 5.8

A tank 1 m³ in volume is filled with air at an absolute pressure of 700 kPa and a temperature of 120°C. The air is discharged to the atmosphere through a valve. Consider air to be a perfect gas. Take $R = 0.287$ kJ/kg K, $c_p = 1.169$ kJ/kg K and $c_v = 0.717$ kJ/kg K. What would be the work that is lost in the kinetic energy of air? Q. 1 (b)

Solution:

The initial state of air in the tank is given by

$$p_i v_i = m_i R T_i \quad \text{or} \quad m_i = p_i v_i/(RT_i).$$

Therefore,

$$m_i = 700 \times 1/(0.287 \times 393) = 6.21 \text{ kg}.$$

Since there is no heat transfer during the discharge, it can be assumed to be a reversible adiabatic process for which

$$T_i/T_f = (p_i/p_f)^{(\gamma - 1)/\gamma}$$

or

$$393/T_f = (700/101.325)^{(1.4 - 1)/1.4}$$

or

$$T_f = T_2 = 226 \text{ K}.$$

all thermodynamic analysis is based on reversible processes and equilibrium states, one must keep i mind that they apply to real processes as well. Whether a process is reversible or irreversible the en states are the same. Hence, between two states, thermodynamics uses ideal processes to arrive at tl quantities of heat and work interactions between the system and its surroundings. Once this is don corrections are made to account for irreversibilities in the processes. It must also be observed th thermodynamic analysis based on first law is central to understanding and predicting the performanc of engines, machines, vehicles and in fact all engineering equipment.

Review Questions

1. What is flow work, as referred to a control volume?
2. Drive the general energy equation stating all assumptions.
3. Derive the steady flow energy equation.
4. Derive the continuity equation in steady flow.
5. Compare the work done in a flow process to that in a non-flow process.
6. Explain the porous plug experiment. Prove that in an adiabatic steady flow of a fluid through a porous pl the enthalpy remains constant.
7. Apply the steady flow energy equation to a
   (a) Nozzle
   (b) Condenser
   (c) Boiler
   (d) Condenser
   (e) Turbine
8. Derive the energy equation for the tank filling process using the
   (a) control mass approach,
   (b) control volume approach.
9. Derive the energy equation for the tank discharge process using the
   (a) control mass approach,
   (b) control volume approach.
10. What is Joule–Thomson coefficient? Explain its significance.

Problems

1. The inlet conditions for air flow in a constant area duct are as follows: $p = 220$ kPa, $T = 373$ K, $v = 150$ m $u = 270$ kJ/kg and $h = 370$ kJ/kg. The exit conditions are $p = 110.3$ kPa, $T = 600$ K, $u = 390$ kJ/kg a $h = 612$ kJ/kg. How much heat has to be added to the system per unit mass?
2. A hydrocarbon gaseous fuel enters an engine at 143 kPa and 187°C with a velocity of 44 m/s. The inlet a exit pipes have the same cross-sectional area of 0.022 m^2. The work done by the engine is 53 kW. Calcul the heat transferred in kJ/kg for exit conditions of 105 kPa and 400 K.
3. Combustion products enter a gas turbine at 576 kPa and 190°C and leave at 110 kPa and 35°C. For a m flow rate of 6,000 kg/h, what would be the power output, if heat losses are limited to 1,800 kJ in 1 h?
4. In an adiabatic flow of a vapour through a nozzle, the final pressure drops to ¼ of the initial pressure 440 kPa. If the enthalpy drop is 88 kJ/kg, find the final velocity. Make suitable assumptions.
5. In an adiabatic flow through a steam nozzle the following parameters are measured:
   (a) mass flow rate, 300 kg/h,
   (b) initial pressure, 1,280 kPa,
   (c) final pressure, 13.5 kPa,
   (d) entrance velocity, 135 m/s and
   (e) exit velocity, 1,080 m/s.
   Determine the enthalpy change.

OR Q.1 (b)

Review Questions

1. What are thermal energy reservoirs?
2. Distinguish between a mechanical and thermodynamic cycle.
3. What is a heat engine?
4. Define thermal efficiency and coefficient of performance and distinguish between them.
5. Explain the working principle of a Carnot engine.
6. Prove the equivalence of Kelvin–Planck and Clausius statements of the second law.
7. Can any engine have efficiency higher than that of a reversible engine?
8. Prove that all reversible engines operating between the same two thermal reservoirs have the same efficiency.
9. Prove that the efficiency of a reversible engine is independent of the nature of the working substance.
10. Derive the absolute thermodynamic temperature scale from first principles.
11. Derive the absolute Rankine and Kelvin scales from the thermodynamic scale.
12. What is a perpetual motion machine of the second kind? Q.2 (a) (ii)
13. Prove the equivalence of the ideal gas and thermodynamic temperature scales.
14. What is absolute zero?
15. What are the limitations of the first law?
16. What is the importance of the second law? Q.2 (a) (iii)
17. Discuss reversibility and irreversibility.
18. Prove that no refrigerator can have a higher COP than a reversible refrigerator operating between the same temperature limits, and all reversible refrigerators operating between the same temperature limits have the same COP. Q.2 (a) (i)
19. Write in terms of only the reservoir temperature, T_H and T_L, expressions for the coefficient of performance of a Carnot refrigerator and a Carnot heat pump.

Problems

1. A Carnot engine operates between two reservoirs at 700 and 300 K. What power will it deliver when it receives 100 kW of heat from the high temperature reservoir?
2. An inventor claims that the engine he has developed records 50% efficiency while operating between a heat source at 500°C and a heat sink at 300°C. Is his claim justified?
3. A reversible engine delivers work at the rate of 80 kW while rejecting heat to the surroundings at the same rate. If the atmospheric temperature is 25°C, find
   (a) the rate of heat supply,
   (b) the temperature of the heat source.
4. If a heat pump operates between a cold environment at – 15°C and warm interiors of 22°C, what would be the COP required to deliver 2 kW to the interiors?
5. A reversed Carnot engine operates between temperature limits of – 20°C and 25°C and rejects 25,000 kJ/h to the surroundings. Calculate the power required to operate the engine.
6. A Carnot engine using wet steam as the working fluid operates between temperature limits of 150°C and 25°C. Sketch a p–V diagram of the cycle. For a work output of 300 kJ, calculate the amount of heat rejected from the working fluid at the lower temperature.
7. A Carnot engine produces 50 kW while operating between temperatures of 500 K and 25°C. At what rate does the engine absorb heat from the source?
8. A Carnot engine receives 1,000 kJ/s from a source at 700 K and delivers 250 kW of power. Determine
   (a) the efficiency of the engine and
   (b) the temperature of the low temperature reservoir.
9. A heat engine operating on the Carnot cycle produces 13.5 kJ of work while operating between temperature limits of 300°C and 5°C. Determine its efficiency.

10. What is the COP of a reversed Carnot engine operating between – 8°C and 30°C that delivers 50,000 kJ/h to the higher temperature reservoir?
11. A Carnot engine uses propane as the working fluid. At the start of the isothermal expansion, the propane is at 500 kPa, 400 K and occupies a volume of 0.05 m^3. The volume at the end of this process is 0.10 m^3, and the temperature at the end of the adiabatic expansion is 273 K. Determine
    (a) the heat added and
    (b) the heat rejected.
12. A Carnot refrigerator removes 20,000 kJ/min from a cold storage at – 20°C. Heat is rejected to the atmosphere at 25°C. Determine the power required. Q.2 (b)
13. An engine using helium as the working fluid operates with maximum pressure and temperature of 1,000 kPa, 800°C. The cycle has an overall volume ratio of 4.2 and minimum pressure and temperature of 101 kPa, 30°C. Determine the thermal efficiency of the cycle.
14. Air conditioning requirement in a building is 23°C and a heat input of 20 kW. How much power is required by a Carnot heat pump if it picks up heat from the atmosphere at – 4°C?
15. A Carnot cycle uses 0.5 kg of steam as a working fluid. At the beginning of the isothermal expansion the working fluid is at 1,200 kPa, 20% quality. At the end of the isothermal expansion, the steam is dry and saturated. During the isothermal compression the steam is at 100 kPa. Calculate
    (a) the efficiency of the cycle and
    (b) the amount of work done per cycle.
16. Five kilograms of nitrogen is to be compressed isothermally in a closed system from 101 kPa, 25°C to 400 kPa. Determine the heat transfer if (a) the process is reversible and (b) the process is irreversible so that 30% more work is required than is the case with the reversible process.
17. Air enters a turbine with negligible velocity. In a reversible adiabatic expansion through the turbine, entry conditions are 40 kN/m^2 and 700°C and exit is at 101 kPa. If the exit velocity is 120 m/s through a cross-sectional area of 0.2 m^2, calculate the power output in kW.

Given a choice between 'orderly' and 'disorderly' states, a system always tends to the disorderly state when it attains equilibrium. This is because the thermodynamic probability of a system in an orderly state is very small compared to the thermodynamic probability of the system in a disorderly state. Only orderly states, however, have potential for doing useful work, and it is for this reason that the tendency of a system toward a state of maximum disorder is often called **the principle of degradation of energy**.

While the first law mandates the conservation of energy, the second law dictates that in all processes, the entropy of the universe should increase. We start wondering whether there is a limit at all for the increase of entropy and if there is will it ever be reached. In all real processes there is a decrease in available energy. If all the available resources are brought to the dead state at some time in the future there will be no more energy for use. At that time the entropy of the universe will be at its maximum, the available energy will be zero. The universe and all matter will be at the same temperature level and the universe will reach according to Clausius, a state of 'thermal death'. With the energy level of the surroundings and systems being the same, it will be impossible to have any type of energy interaction that will produce work.

Review Questions

1. Prove that a general reversible process can be approximated by a combination of reversible adiabatics and isothermals.
2. What happens when two adiabatic lines intersect?
3. Why are adiabatics steeper than isothermals?
4. Show that a general reversible cycle can be approximated by a series of Carnot cycles.
5. State and prove the inequality of Clausius.
6. Prove that entropy is a property of a system.
7. What is the principle of entropy increase?
8. Calculate the change in entropy in the following processes:
   (a) Constant volume
   (b) Constant pressure
   (c) Isothermal
   (d) Reversible adiabatic
   (e) Free expansion
9. How is entropy change calculated in open systems?
10. Describe the use of entropy as a coordinate.
11. State Nernst's heat theorem.
12. Using the third law prove that the specific heats at absolute zero are equal to zero.
13. Prove that at absolute zero the coefficient of volumetric expansion is zero.
14. What is the value of entropy at absolute zero?
15. Prove the unattainability of absolute zero.
16. Are there exceptions to the third law?
17. A closed system can go from one specific state to another specified state by means of several different adiabatic paths. Is the work the same for all paths? Explain.
18. Sketch T–s, p–V, T–v, p–h, h–s and h–v diagrams of a Carnot cycle using ideal gas as a working fluid.

Problems

OR Q 2 (b) (i)

1. Sketch T–s, p–v, T–v, p–h, h–s and h–v diagrams of a Carnot cycle using ideal gas as a working fluid.
2. Air is to be compressed adiabatically from 101 kPa, 25°C to 300 kPa at a rate of 15 kg/h. What is the outlet temperature?

The irreversibility per unit mass of fluid is

$$i = W_{\text{max,useful}} - W_{\text{useful}} = 441 - 350 = 91 \text{ kJ/kg.}$$

3.10 Closure

The concepts of availability, available energy, maximum work, irreversibility, lost work and second law efficiency are the ultimate test of the validity and usefulness of the second law. The laws of thermodynamics elucidate the ground rules for the way nature operates. It is left to the engineer to apply these rules to develop processes, cycles and equipment for enhancing the quality of human life.

Review Questions

1. Differentiate between available and unavailable energy.
2. What is dead state?
3. Give expressions for maximum work for a system exchanging heat with
   (a) the surroundings only,
   (b) a finite reservoir.
4. What is the loss in available energy for a system operating between two thermal reservoirs without delivering work?
5. What are thermodynamic potential functions?
6. What is the maximum work developed by a system exchanging heat only with the surroundings in a non-flow process under isothermal conditions?
7. Prove that for a steady flow isothermal process, the difference in Gibbs function represents the maximum work. OR Q-2 (b) (ii)
8. What is useful work? Develop an expression for useful work in a non-flow, isothermal–isobaric process for a system exchanging heat only with the surroundings.
9. Define availability. Prove that the decrease in availability function represents the maximum useful work obtainable in a non-flow process.
10. Show that the decrease in Darrieus function represents the maximum useful work in a steady flow isothermal process with the system exchanging heat only with the surroundings, where $B = U + pV - T_0 S$ is the Darrieus function.
11. What is irreversibility? Prove that for a system exchanging heat only with the surroundings, the irreversibility $I = T_0 \Delta (S_{\text{surr}} + \Delta S)$.
12. What is second law efficiency? Derive expressions for second law efficiency in the case of a
   (a) heat engine,
   (b) refrigerator.

Problems

1. A tank with a volume of 0.3 m^3 contains air at 101 kPa, 500 K. The surrounding atmosphere is at 101 kPa, 300 K. Determine the availability of the air in the tank.
2. Calculate the availability of a 10-kg block of ice at 0°C if the surrounding atmosphere is at 101 kPa, 25°C.
3. The surroundings are at atmospheric pressure of 101 kPa and 25°C. Considering ideal gas as the system under steady flow, compare its availability when it is at 0°C with that at 50°C.
4. Under non-flow conditions, how will the availability change for the system considered in the previous problem?

Example 7.9

In a reversible steady flow process nitrogen is heated at constant pressure from 125 kPa and 40°C to 80°C. Evaluate the change in entropy per unit mass of nitrogen. OR Q.2 (a)

Solution:

In the absence of changes in KE and PE the first law for the open system under steady flow conditions is

$$dq - w_s = dh.$$

Since there is no work interaction $w_s = 0$. Hence

$$dq = dh.$$

The entropy change for an open system was derived as

$$dS \geq \frac{dQ}{T_{surr}} + \Sigma S\, dm\,.$$

For a steady flow process entropy change within the control volume is zero or $dS = 0$. For the reversible process the equality sign holds. Hence the governing equation for the process is

$$dQ/T_{surr} + \Sigma\, s\, dm = 0$$

$$dQ/T_{surr} = -\Sigma\, s\, dm = -dm\,(s_1 - s_2) = dm\,(s_2 - s_1) = S_2 - S_1.$$

$$\text{Since } dQ/T_{surr} = \int_1^2 dq/T_{surr} = \int_1^2 dh/T_{surr} = \int_1^2 c_p\, dT/T_{surr}$$

$$S_2 - S_1 = \int_1^2 c_p\, dT/T_{surr} = c_p \ln(T_2\ T_1).$$

For nitrogen $c_p = 1.042$ kJ/kg K. Therefore,

$$\Delta S = S_2 - S_1 = 1.042 \times \ln[(80 + 273)/(40 + 273)]$$

$$\Delta S = 0.1253 \text{ kJ/K}$$

7.10 ENTROPY AS A COORDINATE

We have seen that heat transferred in a reversible process may be evaluated from

$$Q_{1-2} = \int_1^2 T\, dS$$

This integral can be interpreted as an area under a reversible path on a diagram with temperature and entropy as coordinates. This is similar to representation of work on a pressure–volume diagram. In Fig. 7.9, the p–V and T–s diagrams indicate the variation of p with V and T with s for a system undergoing a reversible process between states 1 and 2. From the definitions of work and heat it follows that for a reversible process

$$W_{1-2} = \int_1^2 p\, dV \qquad Q_{1-2} = \int_1^2 T\, dS \qquad (7.58)$$

Example 9.1

Obtain an expression for the entropy change as a function of pressure and temperature.

Solution:
Writing the first law in differential form for a reversible non-flow process with 1 kg of ideal gas as the system gives:

$$T\,ds = du + p\,dv. \tag{9.76}$$

Differentiating the enthalpy equation $h = u + pv$ gives:

$$dh = du + p\,dv + v\,dp \tag{9.77}$$

or

$$du + p\,dv = dh - v\,dp. \tag{9.78}$$

Substituting the value of $du + p\,dv$ of Eq. (9.78) into Eq. (9.76) gives:

$$T\,ds = dh + v\,dp. \tag{9.79}$$

But $dh = c_p dT$, and $v = RT/p$.
Thus,

$$T\,ds = c_p dT - RT\frac{dp}{p} \tag{9.80}$$

Dividing by T gives the required expression:

$$ds = C_p\frac{dT}{T} - R\frac{dp}{p}$$

9.10 Closure

The study of property relations poses a tough challenge to students as they are caught in a web of seemingly endless manipulations to the purpose of which they have absolutely no clue. It is emphasized once again that without Maxwell's equations and their application to establishing derivatives of entropy, enthalpy, internal energy and specific heats in the standard form, it would be very difficult to carry out experiments and develop tables of properties of these parameters. By standard form we mean that measurable quantities are brought on the right-hand side of property relations. Before attempting to understand property relations, the rules of partial differentiation have to be mastered by the student. Appendix 2 gives some basics of the mathematics required for the study of thermodynamics.

Review Questions

1. Mention the three $T\,ds$ equations and explain their importance in thermodynamics.
2. What are characteristic functions? Q.3 (b)
3. Using Maxwell's equations express the differentials of u, h, a and g in terms of p, v, T and s.
4. Prove that the internal energy of an ideal gas is a function of temperature only. Q.3 (b)

Prove that for a perfect gas $\beta = 1/T$ and $k = 1/p$.

Find a relation between β and k.

Prove that $c_p - c_v = Tv\beta^2/k$.

The velocity of sound c in a medium is given by $c = \sqrt{\left(\frac{\partial p}{\partial \rho}\right)_s}$. Find an expression for the velocity of sound in terms of such quantities as p, u, T, R and k, for (a) an ideal gas and (b) an incompressible liquid.

Derive an expression for the change in enthalpy of a gas that follows the equation of state $p(v - b) = RT$.

What is Joule-Thomson coefficient? Explain the inversion curve and inversion point.

Determine the Joule-Thomson coefficient of a van der Walls gas in terms of $a, b, T, \bar{R}, \bar{v}, c_p$.

Derive the following expression from fundamental relations: $\left(\frac{\partial u}{\partial v}\right)_T = T\left(\frac{\partial p}{\partial T}\right)_v - p$.

For a single phase of a pure substance, sketch lines of constant entropy and constant temperature on p–V coordinates and prove that the relative slopes shown are correct.

11 Show from the Maxwell equations that for an ideal gas $(\partial u/\partial v)_T = 0$.

Problems

1 By means of Maxwell's relations derive the following $T\,ds$ equations:

$$T\,ds = c_v\,dT + T\frac{\beta}{k}\,dv$$

$$T\,ds = c_p\,dT - v\beta\,dp$$

$$T\,ds = \frac{kc_v}{\beta}\,dp + \frac{c_p}{v\beta}\,dv$$

2 Determine the isothermal compressibility of an ideal gas and a Van der Waals gas.

3 Develop an expression for the enthalpy change of a gas which follows the equation of state $p(v - b) = RT$.

4 The isothermal compressibility and the adiabatic compressibility are defined, respectively, as

$$k_T = -\frac{1}{v}\left(\frac{\partial v}{\partial p}\right)_T; \quad k_s = -\frac{1}{v}\left(\frac{\partial v}{\partial p}\right)_s;$$

(a) Show that the isothermal compressibility is always greater than or equal to the adiabatic compressibility.

(b) Show that if $\gamma = c_p/c_v$, then

$$\gamma = k_T/k_s$$

5 (a) Show that $\left(\frac{\partial c_v}{\partial v}\right)_T = 0$ for a Van der Waals gas.

(b) Calculate the entropy change $s_2 - s_1$ for a Van der Waals gas assuming $c_v = a + bT + cT^2$ where a, b and c are constants.

6 Show that for any substance $c_p - c_v$ can never be negative and c_p can never be less than c_v.

7 From the definition of the Joule-Thomson coefficient, $\mu = \left(\frac{\partial T}{\partial p}\right)_h$, calculate μ for a gas obeying the equation of state

$$p(v - b) = RT$$

where R and b are constant.

$$du = -p\,dv.$$

Now for an ideal gas $du = c_v\,dT$. Hence

$$-p\,dv = c_v\,dT.$$

From $pv = RT$

$$p\,dv + v\,dp = R\,dT = -Rp\,dv/c_v$$

$$p\,dv\,(1 + R/c_v) + v\,dp = 0. \quad (11.25)$$

Substituting for $R = c_p - c_v$ for an ideal gas and dividing throughout by pv, Eq. (11.25) becomes

$$\frac{cp}{cv}\left(\frac{dv}{v}\right) + \frac{dp}{p} = 0$$

Integrating the above and substituting $\gamma = c_p/c_v$ we get as before

$$pv^{\gamma} = \text{const.}$$

Using the above result and the equation of state $pv = RT$ we get

$$Tp^{(1-\gamma)/\gamma} = \text{constant} \quad (11.26)$$

$$Tv^{(\gamma-1)} = \text{constant} \quad (11.27)$$

Example 11.2

A vessel with a volume of 0.1 m³ contains an ideal gas at 100 °C 600 kPa. It expands isentropically to a final pressure of 150 kPa. Evaluate the work done. Assume $c_v = 0.7202$ kJ/kg K and $c_p = 1.0044$ kJ/kg K. OR Q.3 (b)

Solution:

For the isentropic process,

$$s_2 = s_1, \quad Q = 0 \quad \text{and} \quad p_1V_1^{\gamma} = p_2V_2^{\gamma}$$

From the data given,

$$\gamma = \frac{c_p}{c_v} = \frac{1.0044}{0.7202} = 1.3946$$

and

$$R = c_p - c_v = 1.0044 - 0.7202 = 0.2842 \text{ kJ/kg K}$$

The final volume after expansion is evaluated from the isentropic relation

$$V_2 = V_1\left[\frac{p_1}{p_2}\right]^{1/\gamma} = 0.1\left[\frac{600}{150}\right]^{1/1.3946} = 0.27 \text{ m}^3$$

Similarly the temperature after expansion is evaluated from the isentropic relation

$$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$$

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DEPARTMENT OF MECHANICAL ENGINEERING

6th March, 2010

Dr. N.K. Banthiya
Professor & Head

To
The Director (Academics),
Rajasthan Technical University,
Kota

Sir,

Subject: B.Tech. Mechanical Engineering Syllabus

During your visit to our Institute, I had brief discussions with you about B.Tech. (Mech. Engg.) syllabus.

I am enclosing a copy of my comments on the syllabus, which were sent to the University on 2nd June 2009, with a request to look into the various points mentioned by me.

Thanking you,

Yours faithfully,

NBanthiya

(N.K. Banthiya)

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असतो मा सद्गमय

Approved by AICTE, Ministry of HRD, Government of India and Affiliated to Rajasthan Technical University, Kota

SKIT/2009/3232, 3233, 3234

Date : 3.6.2009

To

The Head,
Department of Mechanical Engg.,
University College of Engineering,
Rajasthan Technical University,
Rawatbhata Road, Kota- 324010

Dear Sir,

I enclose herewith some observations regarding B.Tech. Syllabus in Mechanical Engineering Branch by Dr. N. K. Banthiya, Professor and Head Department of Mechanical Engineering of our Institute. You may consider them while revising the syllabus.

Yours Sincerely,

S. L. Surana

Dr. S. L. Surana
Director (Academics)
and Member Academics
Council RTU

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Swami Keshvanand Institute of
Technology, Management & Gramothan
Ramnagaria, Jagatpura, JAIPUR-25

Copy to :

1. The Dean RTU, Kota
2. The Registrar, RTU, Kota

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SWAMI KESHVANAND INSTITUTE OF TECHNOLOGY, MANAGEMENT & GRAMOTHAN, JAIPUR

DEPARTMENT OF MECHANICAL ENGINEERING

NOTE

I am enclosing my comments about Mechanical Engineering Syllabus. It may kindly be forwarded to the concerned authorities in RTU.

NB

(Dr. N.K. Banthiya)

Professor & Head

2nd June, 2009.

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RTU SYLLABUS OF MECHANICAL ENGINEERING & SOME COMMENTS

S.No.	Particulars	Suggestion for Improvement
1.	(a) Workshop Practice for all branches is in the I Semester Due to this, staff and equipment of Workshop get engaged only during I Semester. Although, efforts are made to give work to staff in even semesters, it is not very effective. This problem is severe in Institutions where Mech. branch is not there. These institutions may not employ sufficient number of people. (b) Even in institutions where Mech. branch is there, all load related to Workshop / Production Engg. comes in odd semesters, as can be seen below: 3ME 10 Production Engg. Practice 5ME7 P.E. Lab. I 7ME7 P.E. Lab. II This creates additional problem for the department in odd semesters, as far as resource deployment is concerned. This resource remains almost completely unutilized in even semesters.	Workshop Practice be distributed in two semesters, as has been done in case of Physics & Chemistry laboratories It is requested that necessary changes are made so that balanced resource utilization: man as well as machine occurs in Workshop / Production Engineering
2.	Refrigeration & Air-conditioning lab. or experiments related to it are completely missing from the syllabus.	This is for the course committee to think whether this

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	Most of the institutions have invested sufficient money in building the related lab.	elimination is justified. If it is not, slot has to be found for Refrigeration & Air-conditioning lab. for which there is sufficient scope.
3.	In 3ME8, Material Science and Heat Treatment Lab, 11 experiments have been prescribed, but there is provision of only2/2. It may need reviewing.	Two periods per week, instead of 2 periods in alternate week be provided.
4.	There are three laboratory courses related to Thermal Engineering in which I.C. Engines find a predominant place (3ME9 Thermal Engg. Lab. I, 4ME9 Thermal Engg. Lab. II and 7ME9 I.C. Engines Lab.), in addition to lab. courses : 5ME8 Automobile Engineering Lab. and 6ME8 Turbomachinery Lab. It can be seen that first 10 experiments in 7ME9 are only study exercises, which a student should have done in 3ME9, 4ME9 & 5ME8. Requirement in this course (7ME9) is only 10 experiments, and this lab. course in VII Sem. can be run without doing any experimental work.	It is requested that a thorough study of these courses be done, duplication eliminated and if possible Refrigeration & Air-conditioning experiments be accommodated in these courses.
5.	In 5ME7 Prod. Engg. Lab. I, there are a number of experiments, which have already been included in 3ME8 Material Science & Heat Treatment Lab. (Experiment Nos. 9,10,12,13,14 &15)	Necessary changes in 3ME8 and 5ME7 may kindly be made.

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DEPARTMENT OF MECHANICAL ENGINEERING

NOTE

I am enclosing my comments about Mechanical Engineering Syllabus. It may kindly be forwarded to the concerned authorities in RTU.

(Dr. N.K. Banthiya)

Professor & Head

RTU SYLLABUS OF MECHANICACAL ENGINEERING & SOME COMMENTS

S.No.	Particulars	Suggestion for Improvement
1.	(a) Workshop Practice for all branches is in I Semester Due to this, staff and equipment of Workshop get engaged only during I Semester. Although, efforts are made to give work to staff in even semesters, it is not very effective. This problem is severe in Institutions where Mech. branch is not there. These institutions may not employ	Workshop Practice be distributed in two semesters, as has been done in case of Physics & Chemistry laboratories

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	sufficient number of people. (b) Even in institutions where Mech. branch is there, all load related to Workshop / Production Engg. comes in odd semesters, as can be seen below: 3ME 10 Production Engg. Practice 5ME7 P.E. Lab. I 7ME7 P.E. Lab. II This creates additional problem for the department in odd semesters, as far as resource deployment is concerned. This resource remains almost completely unutilized in even semesters.	 It is requested that necessary changes are made so that balanced resource utilization, man as well as machine occurs.
2.	Refrigeration & Air-conditioning lab. or experiments related to it are completely missing from the syllabus. Most of the institutions have invested sufficient money in building the related lab.	This is for the course committee to think whether this elimination is justified. If it is not, slot has to be found for it for which there is sufficient scope.
3.	In 3ME8, Material Science and Heat Treatment Lab, 11 experiments have been prescribed, but there is provision of only2/2. It may need reviewing.	
4.	There are three laboratory courses related to Thermal Engineering in which I.C. Engines find a predominant place (3ME9 Thermal Engg. Lab. I, 4ME9 Thermal Engg. Lab. II and 7ME9 I.C. Engines Lab.), in addition to courses ~~on~~ 7 5ME8 Automobile Engineering, 6ME8 Turbomachinery Lab. It can be seen that first 10 experiments	It is requested that a thorough study of these courses be done, duplication eliminated and if possible Refrigeration & Air-conditioning experiments be accommodated in these courses.

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	in 7ME9 are only study exercises, which a student should have done in 3ME9, 4ME9 & 5ME8. Requirement in this course (7ME9) is only 10 experiments, and a lab course can be run without performing any experimental work.	
5.	4ME9 Thermal Engg. Lab.II focuses on disassembling and assembling of various engines and their parts. These are excellent exercises, but difficult to implement in institutional setting. Some strategy to achieve the desired objectives may kindly be suggested.	A possible strategy could be to invite some knowledgeable and practical person from an automobile garage and put students under him for doing these exercises.
6.	5ME8 Automobile Engg. Lab. focuses on trouble shooting and fault diagnosis of various sub-systems of an automobile. It also includes valve refacing and grinding exercises. These are excellent exercises, but difficult to implement in institutional setting. Some strategy to achieve the desired objectives may kindly be suggested	For some of these exercises, if garage visit is suggested as a possible strategy, it would be very useful.
7.	In 5ME7 Prod. Engg. Lab. I, there are a number of experiments, which have already been included in 3ME8 Material Science & Heat Treatment Lab. (9,10,12,13,14 &15)	Necessary changes in 3ME8 and 5ME7 may kindly be made.

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