COURSE FILE

Quality Assurance Report – I

(Version: 1.1. 2019-20)

Name of the Faculty	:	NISHCHITHA K.M.
Designation	:	Assistant Professor
Department	:	Mechanical Engineering

SL. No.	Contents			Max. Points	Course 1 Name: EME (C) Code: 18EME25 Points* awarded	Course 1 Remarks	Course 2 Name: AE. Code: 17ME653 Points* awarded	Course 2 Remarks
1.	Course Syllabus with Overview, Objectives and Outcomes			5	05		05	
2.	Course Outcomes mapping with PO & PSO							
3.	Academic Record	Calendar of Events		5	05		05	
4.		Time Table						
5.		Lesson Plan						
6.		Attendance Record						
7.		CIE & Module Test marks						
8.	Notes / Handouts & PPTs			5	05		05	
9.	Previous Examination Papers/ Question Bank			5	05		05	
10.	IA	Facing sheet details	CIE	5	05		05	
			Module Test					
		Marks Entry & Signature	CIE					
			Module Test					
		Assignments / Seminar						
11.	Internal Assessment Question Papers with Scheme & Solution			5	05		05	
12.	Remedial/Tutorial Classes conducted, if applicable			5	–		05	
13.	Beyond Syllabus Activities/New Teaching Learning Initiatives if applicable			5	02		05	
14.	Course Attainment for all batches			5	05		05	
15.	ERP software entries	IA marks of all tests & Assignment / Seminar		5	05.		05	
		Attendance as on last working day						
	TOTAL POINTS			50	48		050	

***Points for Compliance:** Full Compliance = MAX Points; Partial Compliance = Half of Max.; Non-Compliance = 0; Not-Applicable = NA

Average % for all courses handled = 48 + 50. = 98 = 98%.

Verified by

Signature: [signature]

Name: Dr. K.N. Shivakumarswamy

Department: LIS

[signature]

Signature of Faculty

Quality Assurance Report – I

(Version: 1.1. 2019-20)

COURSE FILE

Name of the Faculty	:	NISHCHITHA K.M
Designation	:	Assistant Professor.
Department	:	Mechanical Engineering.

SL. No.	Contents		Max. Points	Course 1 (Name: EME. Code: 18ME15.) Points* awarded	Course 1 Remarks	Course 2 (Name: MPI Code: 18ME35A.) Points* awarded	Course 2 Remarks
1.	Course Syllabus with Overview, Objectives and Outcomes		5	05		05	
2.	Course Outcomes mapping with PO & PSO						
3.	Academic Record	Calendar of Events	5	05.		05	
4.		Time Table					
5.		Lesson Plan					
6.		Attendance Record					
7.		CIE & Module Test marks					
8.	Notes / Handouts & PPTs		5	05		05	
9.	Previous Examination Papers/ Question Bank		5	05		05	
10.	IA	Facing sheet details – CIE / Module Test; Marks Entry & Signature – CIE / Module Test; Assignments / Seminar	5	05.		05	
11.	Internal Assessment Question Papers with Scheme & Solution		5	05.		05	
12.	Remedial/Tutorial Classes conducted, if applicable		5	-		.	
13.	Beyond Syllabus Activities/New Teaching Learning Initiatives if applicable		5	—		.	
14.	Course Attainment for all batches		5	05.		05	
15.	ERP software entries	IA marks of all tests & Assignment / Seminar; Attendance as on last working day	5	05		05	
	TOTAL POINTS		50	40		40	

*** Points for Compliance: Full Compliance = MAX Points; Partial Compliance = Half of Max.; Non-Compliance = 0; Not-Applicable = NA**

Average % for all courses handled = 80 = 80 = 80%

Verified by

Signature:

Name: Dr. K.N. Shivakumarswamy

Department: LIS

Signature of Faculty

LAB COURSE FILE

Quality Assurance Report – II

(Version: 1.1. 2019-20)

Name of the Faculty	:	NISHCHITHA K.M.
Designation	:	Assistant Professor.
Department	:	Mechanical Engg.

Sl. No.	CONTENTS		Max. Points	Lab 1 Name: MMM. Code: 18MELA7A Points* awarded	Lab 1 Remarks	Lab 2 Name: Code: Points* awarded	Lab 2 Remarks
PART – A (PREPARATION BY TEACHING STAFF IN-CHARGE OF LAB)							
1.	Lab Course Syllabus with Overview, Objectives & Outcomes		5	05			
2.	Lab Course Outcomes mapping with PO & PSO		5	05			
3.	Lab Layout with list of Experiments		5	05			
4.	Lab Course Attainment for all batches		5	05			
5.	Notes/Handouts/Manuals Sample Viva Questions		5	05			
	TOTAL POINTS		25	25			
PART – B (PREPARATION BY TEACHING STAFF HANDLING THE LAB)							
1.	Academic Record	Calendar of Events	5	05			
2.		Time Table					
3.		Lesson Plan					
4.		Attendance Record					
5.	Lab Record of current semester students		5	05			
6.	Lab IA Question Papers with Scheme & Solution		5	05			
7.	Beyond Syllabus experiments /Activities		5	–			
8.	Lab IA	Facing Sheet Details Entry	5	05			
		Marks Entry & Signature					
		Record / Manual finalization					
	TOTAL POINTS		25	20			

* Points for Compliance: Full Compliance = MAX Points; Partial Compliance = Half of Max.; Non-Compliance = 0; Not-Applicable = NA

Average % for all courses handled = 20 + 25. = 45. = 90%

Verified by

Signature: [signature]

Name: Dr. K.N. Shivakumarswamy.

Department: HIS

[signature] Signature of Faculty

PERSONAL FILE

Quality Assurance Report – IV

(Version: 1.1. 2019-20)

Name of the Staff	:	NISHCHITHA K.M
Designation	:	Mechanical Engg Assistant Professor.
Department	:	Mechanical Engg.

Sl. No.	CONTENTS		Max. Points	Points* awarded	Remarks
1.	Updated Bio-data		5	05.	
2.	Photocopy of	SSLC, Degree Marks Cards and certificates of all qualifications	5	05	
3.		Professional Certificates, if any			
4.		Skill Up gradation Certificates (for Technical Staff Only)			
5.	Experience Certificates (Outside BGSIT, if any)		5	–	
6.	Membership in Professional Bodies		5	05	
7.	Workload Assigned	Teaching (2.5) Other Non-Academic workload (2.5)	5	05	
8.	Time Table *(Not Applicable to Administrators)*	Even distribution of slots in all Hours (at least 1 hour in all slots)	5	05.	
9.	Organizing or Attending Workshops/FDP/Training/ Summit /Seminar *(Consider only 2018 – 19)*	Attending – Duration (days): One or Two / Three or more In-house: 1 / 2 Outside: 3 / 5 Organizing: 3 / 5	5	05	
10.	Conference Details till date *(at least one for each year of service)*	Ratio of Number of Conferences Organized / Publication of Paper in Conference to Number of years of service *10	10	05	
11.	Journal Publications of previous Years *(at least one for each year of service)*	Ratio of Number of papers published to Number of years of service *10	10	–	
12.	*Paper publication of current semester (Web of Science & Scopus indexed journal only)*	Submitted (3) Accepted & Published (5)	5	05.	
13.	Invited / Technical talk	Organized / Delivered / Attended (Min. one in each semester)	5	–	
14.	Proposals to funding agencies	Submitted / Sanctioned	5	–	
15.	Consultancy work and Outreach (If opted) (Minimum 1 activity per sem)		5	–	
16.	Committees Membership (College/ Department Level)	Proof of formation	5	05	
		Ratio of number of meetings attended to Number of meetings held * 5	5		
		Feedback from Coordinator/HOD/Principal	5	05	
17.	Additional Duties & Responsibilities assigned (if applicable)		5	05	
18.	Counseling / Mentoring of needy students		5	05.	
	TOTAL POINTS		100	60	

*Points for Compliance: Full Compliance = MAX Points; Partial Compliance = Half of Max.; Non-Compliance = 0; Not-Applicable = NA

Average %= 60 / ______ = 60 = 60%.

Verified by

Signature:

Name: Dr. K.N. Shivakumaraswamy

Department: LIS.

Signature of Faculty

||Jai Sri Gurudev||

BGS INSTITUTE OF TECHNOLOGY

BG Nagara –571448, Nagamangala Taluk

ACADEMIC AUDIT for the Academic year ----2019-20 (ODD/EVEN)	
Name of the Faculty with Designation	NISHCHITHA KM, Asst Professor
Course Name with code	18MEI5 EME. (F)

Sl. No.	Contents	Semester	
1	Faculty profile	Theory	Lab
2	Vision and Mission of the Institute, Department, PEOs, PSOs, POs	✓	
3	Calendar of Events (University, Institute and Department)	✓	
4	Timetable (Class and Individual)	✓	
5	Syllabus copy, CO – PO – PSO Mapping (with justification)	✓	
6	Lesson Plan	✓	
7	Previous Year University QPs & Question Bank	✓	
8	Notes	✓	
9	Assignments	✓	
10	Assessment Tools & procedure for assessment of COs (IA Test, Assignment, Quizzes, SEE)	✓	
11	Innovative teaching methods	✓	
12	List of slow learners & remedial classes	✓	
13	Procter Details (for allotted students)	✓	
14	Report of guest lectures for the course if any	✓	
15	Feedback report	✓	
16	Course End Survey	✓	
17	CO attainment	✓	
18	Result Analysis	✓	
19	PO / PSO attainment	✓	
20	Review of attainment (course attainment)	✓	

Faculty Nishchitha km.

HOD

Head of the Department
Department of Mechanical Engineering
BGSIT B G Nagara 571448

Internal Auditor

External Auditor

Coordinator -IQAC
B.G.S. INSTITUTE OF TECHNOLOGY
B.G.Nagara -571 448

Note! Review of attainment is not done

||Jai Sri Gurudev||

BGS INSTITUTE OF TECHNOLOGY

BG Nagara –571448, Nagamangala Taluk

ACADEMIC AUDIT for the Academic year ---- 2019-20 (ODD/EVEN)	
Name of the Faculty with Designation	NISHCHITHA KM, Asst Professor
Course Name with code	MPI 18ME34

Sl. No.	Contents	Semester	
		Theory	Lab
1	Faculty profile		
2	Vision and Mission of the Institute, Department, PEOs, PSOs, POs	✓	
3	Calendar of Events (University, Institute and Department)	✓	
4	Timetable (Class and Individual)	✓	
5	Syllabus copy, CO – PO – PSO Mapping (with justification)	✓	
6	Lesson Plan	✓	
7	Previous Year University QPs & Question Bank	✓	
8	Notes	✓	
9	Assignments	✓	
10	Assessment Tools & procedure for assessment of COs (IA Test, Assignment, Quizzes, SEE)	✓	
11	Innovative teaching methods	✓	
12	List of slow learners & remedial classes	✓	
13	Procter Details (for allotted students)	✓	
14	Report of guest lectures for the course if any	✓	
15	Feedback report	✓	
16	Course End Survey	✓	
17	CO attainment	✓	
18	Result Analysis	✓	
19	PO / PSO attainment	✓	
20	Review of attainment (course attainment)	✓	

Faculty: Nisht km

HOD

Head of the Department
Department of Mechanical Engineering
BGSIT B G Nagar-571448

Internal Auditor

External Auditor

Coordinator -IQAC
B.G.S. INSTITUTE OF TECHNOLOGY
B.G.Nagara -571 448

Note! Justification for CO-PO-PSO mapping should be done

||Jai Sri Gurudev||

BGS Institute of Technology

Department of Mechanical Engineering

Academic year 2019-20 (ODD / EVEN)	
Name of the Faculty with Designation	NISHCHITHA K M
Course Name with code	Manufacturing Process 1 18ME34

Feed Back Report					No. of Students participated= 30					
Feedback Questions	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Av. Rating	9	9	9	9	8	9	8	8	8	8
Overall Feedback										

Course End Survey						
CO's	CO.1	CO.2	CO.3	CO.4		
Av. Rating	2.30	2.28	2.33	2.37		

CO Attainment						
CO's	CO.1	CO.2	CO.3	CO.4	CO.5	CO.6
Attainment	2.28	2.30	2.70	2.74		

PO / PSO Attainment														
PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Attainment	2.54	1.70	1.65	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54	2.54

Analysis of CO, PO/PSO Attainment [Review of attainment (course attainment)]

POS · PO6 PO7 PO8 PO9 PO10 are not mapped. PO12 Needs to map for upcoming year.

||Jai Sri Gurudev||

BGS Institute of Technology

Department of Mechanical Engineering

Result Analysis CIE				
	Test-1	Test-2	Test-3	IA
22 (More than 76%)	34	28	35	
12-22 (41% to 75%)	02	02	03	
12 (less than 40%)	09	00	07	
TOTAL no of students	45	30		

Action taken for Slow learners:

Test-1 Remedial classes are conducted. to Improve marks for Next

Test-2 there is no slow learners.

Result Analysis SEE					
Course name with Code	Total Appeared	FCD	FC	Pass %	Failed
MPI 18ME34.	45	13	09	93	3

Remarks By conducting the classes Beyond. syllabus improve the performance to Next year.

Faculty

HOD
Head of the Department
Department of Mechanical Engineering
BGSIT B G Nagar-571

ADICHUNCHANAGIRI UNIVERSITY (Formerly BGSIT)

I Sem F sec

BGS Institute of Technology

Chemistry (CHE)

Course Name : ELEMENTS OF MECHANICAL ENGINEERING (18ME15)

Class : Semester 1 F

Ms Nishchitha K M
Assistant Professor,
2019-20

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1 . Academic calendar 2019-20 (Semester 1)

Date	Day	Event
5 Aug 2019	MONDAY	Term Start Date
5 Aug 2019	MONDAY	Registration & Commencement of 1st Semester Classes
12 Aug 2019	MONDAY	Bakrid V Eid al Adha
15 Aug 2019	THURSDAY	Independence Day
2 Sep 2019	MONDAY	Ganesh Chaturthi
10 Sep 2019	TUESDAY	Muharram
20 Sep 2019	FRIDAY	Test 1 Progress Report Dispatch
21 Sep 2019	SATURDAY	Class Teachers Meeting
2 Oct 2019	WEDNESDAY	Gandhi Jayanti
3 Oct 2019	THURSDAY	Test 1
4 Oct 2019	FRIDAY	Test 1
5 Oct 2019	SATURDAY	Test 1
7 Oct 2019	MONDAY	Maha Navami
8 Oct 2019	TUESDAY	Vijaya Dashami
11 Oct 2019	FRIDAY	Test 1 Progress Report Dispatch
12 Oct 2019	SATURDAY	Class Teachers Meeting
24 Oct 2019	THURSDAY	Test 2
24 Oct 2019	THURSDAY	Test 2
25 Oct 2019	FRIDAY	Test 2
25 Oct 2019	FRIDAY	Test 2 Progress Report Dispatch
25 Oct 2019	FRIDAY	Test 2
26 Oct 2019	SATURDAY	Test 2

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BGS Institute of Technology

Department of Chemistry (CHE)

Date	Day	Event
26 Oct 2019	SATURDAY	Test 2
29 Oct 2019	TUESDAY	Balipadyami
1 Nov 2019	FRIDAY	Kannada Rajyothsava
8 Nov 2019	FRIDAY	Test 2 Progress Report Dispatch
9 Nov 2019	SATURDAY	Class Teachers Meeting
15 Nov 2019	FRIDAY	Kanakadasa Jayanti
21 Nov 2019	THURSDAY	Test 3
22 Nov 2019	FRIDAY	Test 3
23 Nov 2019	SATURDAY	Test 3
28 Nov 2019	THURSDAY	Test 3 Progress Report Dispatch
29 Nov 2019	FRIDAY	Class Teachers Meeting
30 Nov 2019	SATURDAY	Last Working Day
5 Dec 2019	THURSDAY	Test 3
6 Dec 2019	FRIDAY	Test 3
7 Dec 2019	SATURDAY	Test 3
12 Dec 2019	THURSDAY	Test 3 Progress Report Dispatch
13 Dec 2019	FRIDAY	Class Teachers Meeting
14 Dec 2019	SATURDAY	Last Working Day
21 Dec 2019	SATURDAY	Term End Date

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2 . Timetable

	1	2	3	4		5	6	7
	09:00 AM 09:55 AM	09:55 AM 10:50 AM	11:00 AM 11:55 AM	11:55 AM 12:50 PM	12:50 PM 01:45 PM	01:45 PM 02:35 PM	02:35 PM 03:25 PM	03:25 PM 04:15 PM
MON							BE 18ME34 ME Semester 3 A	
TUE	BE 18ME34 ME Semester 3 A			BE 18ME15 CHE Semester 1 F				
WED		BE 18ME34 ME Semester 3 A		BE 18ME15 CHE Semester 1 F				
THU			BE 18ME34 ME Semester 3 A					
FRI			BE 18ME15 CHE Semester 1 F					
SAT		BE 18ME15 CHE Semester 1 F		BE 18ME34 ME Semester 3 A		BE 18ME15 CHE Semester 1 F		

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3 . Department Details

5 . 1 Preliminary Information

PROGRAM EDUCATIONAL OBJECTIVES

Peo 1 : To produce engineers with in-depth knowledge of Basic engineering concepts in mathematics, physics, chemistry, mechanical, civil, electrical and electronics, computer science and biological sciences for engineering application

Peo 2 : To train the students with technical skills in biotechnology and interdisciplinary field to meet the industrial demands

Peo 3 : To upgrade the skills in microbial processes and computer based applications in Biotechnology

Peo 4 : To expertise the students with analytical and problem solving abilities with special emphasis on research, entrepreneurship and career

Peo 5 : To create responsible biotechnology engineers with high ethical and moral values

PROGRAM OUTCOMES(PO's)

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

2. **Problem Analysis :** Identify, formulate, review research literature, and analyze 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 the public health and safety, and the 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 the 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 engineering practice

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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 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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4 . Course Information

6 . 1 Course Content

Title of the Course : ELEMENTS OF MECHANICAL ENGINEERING
Academic Year : 2019-20
Semester : 1

Subject Code : 18ME15	IA Marks : 40
Hours/week : 4	Total Hours : 50
Exam Hours : 3	Exam Marks : 60
Course Plan Author : Nishchitha K M	Planned Date : 2019-08-20
Approved by : Mr YUVARAJA B K	Approved Date : 2019-08-20
Objectives: 1 .	
Course Outcomes (COs) : 1 . Develop the basic knowledge of Energy sources, Boilers, IC engines and Refrigeration & Air conditioning systems, 2 . Understand the various Machine tools, Metal joining processes, Power transmission systems and Bearings & Lubrication systems 3 . Understand the applications of various Engineering & Composite materials.	

6 . Course Information

6 . 1 . 2 Text Books and Reference Books

TEXT BOOKS :

1 . K. R. Gopalakrishna, Sudhir Gopalakrishna, S. C. Sharma, "Text Book of Elements of Mechanical Engineering", Subhas Publications, 2015.

2 . S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology – Vol-1&2", Media Promoters & Publishers Pvt. Ltd., 2010.

REFERENCE BOOKS :

1 . S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", IK International Publishing Pvt. Ltd., 2010.

2 . Kestoor Praveen & Ramesh, "Elements of Mechanical Engineering", Suggi Publishing, 2015.

. K. V. A. Balaji & K. Ramashastry, "Elements of Mechanical Engineering Sciences", Sanguine Technical Publishers,

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6. Course Information

6. 2

Semester: 1 **Section:** F **Course:** ELEMENTS OF MECHANICAL ENGINEERING

Period	Planned			Execution		
	Date	Topic	Source material to be referred	Date	Topic	Source material to be referred
			1			
1	2019-08-20	Energy Sources: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-20	Energy Sources: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
2	2019-08-21	Energy Sources: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-21	Energy Sources: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
3	2019-08-23	Types & Examples	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-23	Types & Examples	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
4	2019-08-24	Solar Power Plant	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-24	Solar Power Plant	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
5	2019-08-24	Hydroelectric Power Plant & Wind Power Plant.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-24	Hydroelectric Power Plant & Wind Power Plant.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
6	2019-08-27	Steam formation, Steam properties \u2013 Dryness fraction, Sensible heat, Latent heat, Total heat, Specific volume & Internal energy, Types of Steam (No numerical problems).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-27	Steam formation, Steam properties \u2013 Dryness fraction, Sensible heat, Latent heat, Total heat, Specific volume & Internal energy, Types of Steam (No numerical problems).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,

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7	2019-08-28	Introduction, Classification, List & Functions of Boiler Mountings & Accessories (No constructional details), [Self Study: Babcock & Wilcox Boiler].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-28	Introduction, Classification, List & Functions of Boiler Mountings & Accessories (No constructional details), [Self Study: Babcock & Wilcox Boiler].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
8	2019-08-30	Steam Turbines: Introduction, Working Principle of Impulse & Reaction Turbines.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-30	Steam Turbines: Introduction, Working Principle of Impulse & Reaction Turbines.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
9	2019-08-31	Introduction, Working Principle of Open and Closed cycle Gas Turbines.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-31	Introduction, Working Principle of Open and Closed cycle Gas Turbines.	Text 1, Text 2. Ref 1, Ref 2, Ref 3,
10	2019-08-31	Introduction, Working Principle of Pelton and Kaplan Turbines.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-08-31	Introduction, Working Principle of Pelton and Kaplan Turbines.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
2						
11	2019-09-03	Introduction, Classification	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-03	Introduction, Classification	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
12	2019-09-04	Parts, Terminology	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-06	Parts, Terminology	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
13	2019-09-06	P-V Diagrams of Otto and Diesel Cycles, Simple Numerical Problems on Indicated Power	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-11	P-V Diagrams of Otto and Diesel Cycles, Simple Numerical Problems on Indicated Power	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
14	2019-09-07	Brake Power, Mechanical Efficiency	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-18	Brake Power, Mechanical Efficiency	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
15	2019-09-07	Indicated Thermal Efficiency and Brake Thermal Efficiency, [Self Study: Working of 2-Stroke & 4-Stroke IC Engines].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-19	Indicated Thermal Efficiency and Brake Thermal Efficiency, [Self Study: Working of 2-Stroke & 4-Stroke IC Engines].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,

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16	2019-09-11	Introduction, Definitions \u2013 Refrigerating Effect	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-20	Introduction, Definitions \u2013 Refrigerating Effect	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
17	2019-09-13	Ton of Refrigeration, Unit of Refrigeration	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-21	Ton of Refrigeration, Unit of Refrigeration	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
18	2019-09-14	Coefficient of Performance (COP), Refrigerants \u2013 Properties & Commonly Used	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-21	Coefficient of Performance (COP), Refrigerants \u2013 Properties & Commonly Used	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
19	2019-09-14	Principle and Working of Vapour Compression and Vapour Absorption Refrigerators, Introduction to Air conditioning	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-21	Principle and Working of Vapour Compression and Vapour Absorption Refrigerators, Introduction to Air conditioning	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
20	2019-09-17	Working Principle of Domestic Air Conditioner.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-24	Working Principle of Domestic Air Conditioner.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
3						
21	2019-09-18	Turning Machine: Parts, Classification and Operations performed (Turning	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-25	Turning Machine: Parts, Classification and Operations performed (Turning	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
22	2019-09-20	Taper turning	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-27	Taper turning	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
23	2019-09-21	Facing	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-09-30	Facing	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
24	2019-09-21	Knurling	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-01	Knurling	Text 1, Text 2, Ref 1, Ref 2, Ref 3,

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25	2019-09-24	Thread cutting).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-09	Thread cutting).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
26	2019-09-25	Working Principle of Drilling, Classification and Operations performed (Boring, Reaming, Tapping, Counter Sinking & Counter Boring).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-09	Working Principle of Drilling, Classification and Operations performed (Boring, Reaming, Tapping, Counter Sinking & Counter Boring).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
27	2019-09-27	Working Principle of Grinding, Working Operation of Surface Grinding, Cylindrical Grinding & Centerless Grinding.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-11	Working Principle of Grinding, Working Operation of Surface Grinding, Cylindrical Grinding & Centerless Grinding.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
28	2019-09-28	Welding: Definition, Classification, Advantages, Disadvantages, Applications, Brief Discussion on Electric Arc Welding & Oxy-Acetylene Gas Welding, Types of Gas Flames.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-15	Welding: Definition, Classification, Advantages, Disadvantages, Applications, Brief Discussion on Electric Arc Welding & Oxy-Acetylene Gas Welding, Types of Gas Flames.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
29	2019-09-28	Definition, Applications, Working Principle, Types of Solder.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-16	Definition, Applications, Working Principle, Types of Solder.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
30	2019-10-01	Definition, Applications, Working Principle, Comparison of Welding, Soldering & Brazing.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-16	Definition, Applications, Working Principle, Comparison of Welding, Soldering & Brazing.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
4						
31	2019-10-09	Belt Drives: Types (Open & Crossed)	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-12	Belt Drives: Types (Open & Crossed)	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
32	2019-10-11	Definitions \u2013 Velocity Ratio	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-12	Definitions \u2013 Velocity Ratio	Text 1, Text 2, Ref 1, Ref 2, Ref 3,

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33	2019-10-12	Creep	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-13	Creep	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
34	2019-10-12	Slip.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-16	Slip.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
35	2019-10-15	Types (Idler	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-19	Types (Idler	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
36	2019-10-16	Stepped Cone and Fast & Loose).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-21	Stepped Cone and Fast & Loose).	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
37	2019-10-18	Introduction, Types of Gear Train	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-22	Introduction, Types of Gear Train	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
38	2019-10-19	[Simple Numerical Problems].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-23	[Simple Numerical Problems].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
39	2019-10-19	Bearings: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-10-30	Bearings: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
40	2019-10-22	Types \u2013 Ball & Roller Bearings.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-01	Types \u2013 Ball & Roller Bearings.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
41	2019-10-23	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-26	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,

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42	2019-10-30	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-27	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
43	2019-11-02	Types and Applications of Ferrous & Non-Ferrous Metals and Alloys	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-29	Types and Applications of Ferrous & Non-Ferrous Metals and Alloys	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
44	2019-11-05	Ceramics and Polymers.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-29	Ceramics and Polymers.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
45	2019-11-06	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-30	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
46	2019-11-08	Classification	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-12-02	Classification	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
47	2019-11-09	Advantages	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-12-03	Advantages	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
48	2019-11-09	Limitations	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-12-02	Limitations	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
49	2019-11-12	Industrial Applications.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,	2019-11-06	Industrial Applications.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,

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6 . Course Information

6 . 2 . 1 Compliance Report

Semester : 1 **Section :** F **Course :** ELEMENTS OF MECHANICAL ENGINEERING

Module No.	# of Classes Planned(till date)	Planned Effort(till date)	# of Classes Executed(till date)	Actual Efforts(till date)	% Coverage
1	10	9hrs 10min	10	9hrs 10min	100.0
2	10	9hrs 10min	10	9hrs 10min	100.0
3	10	9hrs 10min	10	9hrs 10min	100.0
4	10	9hrs 10min	10	9hrs 10min	100.0
5	9	8hrs 15min	9	8hrs 15min	100.0

6 . Course Information

6 . 2 . 2 CO PO Mapping

Slight (Low) = 1 , Moderate (Medium) = 2 , Substantial (High) = 3 .

CO/ PO	1	2	3	4	5	6	7	8	9	10	11	12
CO 1	3	2	2	1		1	2			1		1
CO 2	3	1	1	1	2	2	2	2	2	1	1	1
CO 3	3	2			1	2	3	3	1	2	1	

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6 . Course Information

6 . 3 Other Assessment

ASSIGNMENT : 1

Semester:1-CBCS 2018

[redacted]

Faculty : Nishchitha K M

Max Marks: 10

Answer All Questions				
Q.No		**Max Marks**	**CO**	**BT/ CL**
1		10	123	L2

Evaluation

USN	Name	Present (P) / [redacted]	IA Total	Blooms Level
	Manjunath B	P	10	Understand
	Manoj P	P	10	Understand
	Mohammed Shahid Pasha	P	10	Understand
	Mohankumar G T	P	10	Understand
	Namithgowda D R	P	10	Understand
	Nandan B S	P	10	Understand
	Nayana R	P	10	Understand
	Nikhil Gowda H N	P	10	Understand
	Omkar A	P	10	Understand
	Pavankumar C G	P	10	Understand
	Rakshith Gowda G S	P	10	Understand
	Rakshith N G	P	10	Understand
	Rakshithgowda B	P	10	Understand
	Ravikumar C P	P	10	Understand
	Revanth N R	P	10	Understand

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USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
	Sagar S R	P	10	Understand
	Sangeetha C K	P	10	Understand
	Saniya Saba	P	10	Understand
	Sathvik S A	P	10	Understand
	Shravya J M	P	10	Understand
	Shubha Khadri L	P	10	Understand
	Sinchana Aradhya S B	P	10	Understand
	Sinchana B P	P	10	Understand
	Sinchana C	P	10	Understand
	Sindhushree C N	P	10	Understand
	Subramanian V	P	10	Understand
	Sudeep D C	P	10	Understand
	Suhas Devanga H K	P	10	Understand
	Sunil R	P	8	Understand
	Surajprasad R	P	0	Understand
	Susheelkumar H S	P	10	Understand
	Suvin T S	P	10	Understand
	Tejas	P	10	Understand
	Thejas A	P	10	Understand
	Thejaswini K R	P	10	Understand
	Thrupthi M N	P	10	Understand
	Umme Hani N	P	10	Understand
	Varsha H C	P	10	Understand
	Varshini J	P	10	Understand
	Varun K S	P	10	Understand
	Varun M S	P	10	Understand
	Vibha B	P	10	Understand
	Vidya R Gowda	P	10	Understand

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USN	Name	Present (P) / Absent (Ab)	Q1	Q2		Q3		Q4		IA Total	BT/CL
			a	a	b	a	b	a	b		
2019BEME053	Thejaswini K.r	P	15	0	0	8	6	7	0	29	Understand

Internal : 3

Semester:1-CBCS 2018

Date : 07/12/2019

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18ME15)

Time : 15:00 - 16:00

Faculty : Nishchitha K M

Max Marks: 30

Part A

Answer any 1 questions

Q.No			Max Marks	CO	BT/CL
1	a	Explain the types of belt-drive with neat sketch, mention its advantageas and dis-advantages.	12	3	L2
1	b	Explain the trminologies in belt drive.	3	3	L2
2	a	Give brief classification on ferrous and non ferrous metals.	7	3	L2
2	b	Explain the following, a)Pig Iron b)wrought Iron c)white cast iron	8	3	L2

Part B

Answer any 1 questions

Q.No			Max Marks	CO	BT/CL
3	a	What are the types of steels, list its applications.	15	3	L2
4	a	What is composite? What is the classification of composites? explain.	15	3	L2

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USN	Name	Present (P) / Absent (Ab)	Q1	Q2		Q3		Q4		IA Total	BT/CL
			a	a	b	a	b	a	b		
2019BEME052	Thejas A	P	0	8	2	0	0	1	8	19	Understand
2019BEMEN05	Darshan B.g	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME036	Revanth N.R	P	0	0	0	5	5	0	0	10	Understand
2019BEMEN08	Jeevitha M T	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME040	Saniya Saba	P	15	0	0	9	6	0	0	30	Understand
2019BEMEN01	Ajay A c	P	15	0	0	8	5	0	0	28	Understand
2019BEME054	Thrupthi M N	P	6	2	6	0	0	7	6	21	Understand
2019BEMEN04	Bahuguna V	P	15	0	0	0	0	0	0	15	Understand
2019BEME027	Sinchana Aradhya S B	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME020	Nandan B S	P	0	8	7	0	0	0	3	18	Understand
2019BEME059	Vidya R Gowda	P	15	0	0	9	6	0	0	30	Understand
2019BEME021	Nikhil Gowda H N	P	0	5	2	0	0	0	0	7	Understand
2019BEME017	Mohammed Shahid Pasha	P	0	0	0	0	0	0	0	0	No Level
2019BEME049	Susheelkumar H S	P	5	0	0	0	0	6	7	18	Understand
2019BEME033	Vinay M	P	9	0	0	8	6	2	0	23	Understand
2019BEME016	Manoj P	P	10	0	0	7	4	0	0	21	Understand
2019BEME034	Nayana R	P	9	5	0	7	1	6	8	23	Understand
2019BEME055	Umme Hani N	P	15	0	0	9	6	0	0	30	Understand
2019BEME028	Subramanian V	P	0	0	0	8	0	0	0	8	Understand
2019BEMEN03	Akshay	P	12	0	0	8	6	0	0	26	Understand
2019BEMEN06	Deepal Gowda M	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME047	Suhas Devanga H K	P	15	0	0	0	0	7	8	30	Understand
2019BEME062	Yashaswini T P	P	15	0	0	0	0	7	8	30	Understand
2019BEME024	Rakshith Gowda G S	P	0	6	5	0	4	0	0	15	Understand
2019BEME056	Varsha H C	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME041	Sathvik S A	P	9	0	0	0	0	7	8	24	Understand
2019BEMEN14	Madan K.n	P	5	0	0	0	2	0	0	7	No Level
2019BEME037	Ruchitha M.V	P	12	0	0	0	0	6	7	25	Understand
2019BEME063	Shashank K R	P	14	0	0	0	0	0	0	14	Understand
2019BEME046	Sindhushree C N	P	10	0	0	8	6	0	0	24	Understand
2019BEME048	Sunil R	P	15	0	0	0	0	5	7	27	Understand
2019BEME051	Tejas	P	13	0	0	0	0	0	3	16	Understand
2019BEME061	Vijay A S	P	15	0	0	0	0	0	5	20	Understand
2019BEME032	Varun M S	P	15	0	0	0	0	7	3	25	Understand
2019BEMEN07	Ganeshchar B	P	0	3	6	2	0	0	0	11	Understand
2019BEMEN12	Lohith K.h	P	15	0	0	0	0	3	5	23	Understand

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Evaluation

USN	Name	Present (P) / Absent (Ab)	Q1	Q2		Q3		Q4		IA Total	BT/CL
			a	a	b	a	b	a	b		
2019BEME035	Rakshith N.g	P	12	0	0	0	0	7	4	23	Understand
2019BEME043	Shubha Khadri L	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME058	Vibha B	P	15	0	0	8	6	0	0	29	Understand
2019BEME023	Pavankumar C G	P	0	7	1	0	6	0	0	14	Understand
2019BEME031	Varun K.s	P	0	0	5	1	0	5	0	10	Understand
2019BEME030	Surajprasad R	P	1	0	0	0	0	0	0	1	No Level
2019BEME025	Rakshithgowda B	P	0	8	6	2	6	0	0	22	Understand
2019BEMEN09	Kiran B	P	0	2	0	4	0	7	6	15	Understand
2019BEME018	Mohankumar G.t	P	10	0	0	3	0	0	0	13	Understand
2019BEME026	Ravikumar C.p	P	0	4	4	0	0	7	6	21	Understand
2019BEME045	Sinchana C	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME038	Sagar S.r	P	0	0	0	2	6	0	0	8	Understand
2019BEME057	Varshini J	P	15	0	0	8	6	0	0	29	Understand
2019BEME042	Shravya J.m	P	15	0	0	6	6	0	0	27	Understand
2019BEMEN11	Likhith S.j	Ab	0	0	0	0	0	0	0	0	No Level
2019BEMEN10	Kiran Gowda H K	P	15	2	0	9	6	0	0	30	Understand
2019BEME015	Manjunath B	P	15	0	0	0	0	7	8	30	Understand
2019BEMEN02	Akash M	P	15	0	0	2	4	3	4	22	Understand
2019BEME050	Suvin T.s	P	6	0	0	0	0	7	8	21	Understand
2019BEME060	Vidyashree M	Ab	0	0	0	0	0	0	0	0	No Level
2019BEME022	Omkar A	Ab	0	0	0	0	0	0	0	0	No Level
2019BEMEN13	Lokesh N M	P	8	0	0	0	0	0	0	8	Understand
2019BEME029	Sudeep D.c	P	15	0	0	6	5	0	0	26	Understand
2019BEME039	Sangeetha C.k	P	12	0	0	8	6	0	0	26	Understand
2019BEME019	Namithgowda D R	P	0	8	7	9	6	0	0	30	Understand
2019BEME044	Sinchana B P	P	15	8	7	6	6	0	0	27	Understand

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Internal : 2

Date : 06/11/2019

Semester:1-CBCS 2018

Time : 11:00 - 12:00

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18ME15)

Max Marks: 30

Faculty : Nishchitha K M

Q.No			Max Marks	CO	BT/ CL
1	a	with neat sketches , explain following opearations? a)facing b)turnng c) knurling d) reaming e) counter boring	15	123	L2
2	a	with neat sketch explain working principle and constructional features of centerless grinding machine	8	123	L2
2	b	sketch and explain oxy-acetylene welding?	7	123	L2

Part B

Answer any 1 questions

Q.No			Max Marks	CO	BT/ CL
3	a	what is welding? explain electric arc welding with a neat sketch	9	23	L2
3	b	distinguish between brazing and welding	6	23	L2
4	a	explain the properties of lubricants	7	23	L2
4	b	with neat diagram explain the follwing lubricators a)drop feed lubricator b)splash lubrication	8	23	L2

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Question Number	Solution	Marks Allocated
	called as capity of refrigerator and is expressed in KJ/sec or KW.	
	(ii) Ton of Refrigeration : the capacity of a refrigerator can be expressed in terms of ton of refrigeration, which is also the unit of refrigeration.	
	(iii) COP : the performance of a refrigerator is measured by a factor known as coefficient of performance, simply termed as COP.	
	$COP = \frac{\text{amount of heat removed}}{\text{work supplied}}$	
	$COP = \frac{Q}{W}$	
	each carries 2 marks.	
	2×3 = 6	6M
	21/10/2019.	

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Question Number	Solution	Marks Allocated
3(a)	2 stroke 4 stroke. → → → → 9 points each carries one mark. 9×1 = 9	9 M.
3(b)	Thermal properties. → → → Chemical properties → → → Physical properties → → → others. 6×1 = 6	6M.
4(a)	Vapour absorption refrigeration system Diagram - 3M Construction - 3M Working - 3M 3+3+3 = 9	9M.
4(b)	Explain the following (i) refrigeration effect : the amount of cooling produced by the refrigeration process is known as refrigerating effect. In other words, it can be defined as the rate at which heat is removed from the system in one cycle of operation. Refrigerating effect is also	

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Question Number	Solution	Marks Allocated
2(b)	Classification of IC engine with explanation. (1) According to the type fuel used fuel (a) PE (b) DE (c) GE (d) BE (2) According to the method of ignition (a) SI (b) CI. (3) The Number stroke per cycle (a) 2 - stroke (b) 4 - stroke (4) The cycle of combustion (a) Otto (b) Diesel (c) Dual (5) Number of cylinders (a) single (b) Multi (6) Arrangement of cylinders (a) VE (b) HE (c) IE (d) RE (e) V-engine (f) opp - engine (7) Method of cooling (a) Water (b) Air (8) Uses. (a) SE (b) AE (c) ME (d) AC E. 8x1: 8	8M

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2 Scheme of Evaluation

BGSIT	Doc. Title: Internal Test Scheme	Doc. No.: 06#Form#03

CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution – 1st Test

Date: 1/10/19

Semester: 1st   Subject Title: Elements of Mechanical Engineering   Subject Code: 18EME15

Question Number	Solution	Marks Allocated
1(a)	~~Diagram~~ Impulse turbine Diagram – 2 Marks Explanation – 3M. Reaction turbine Diagram – 2M Explanation – 3M 2+3=5 2+3=5	10M
(b)	5 Comparesition each carries one marks 5×1=5	5M
2(a)	η_m = IMEP = 7.5 Bar – 2M BMEP = Pmb = 6.03 Bar – 2M BSFC = 0.348 kg/k-w-hr – 1M η_{BTH} = 24.7% – 1M η_{ITH} = 30.79% – 1M with solution. 7×1=7 2+2+1+1+1=7	7M

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USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
2019BEME034	Nayana R	P	0	0	0	8	7	2	4	0	17	Understand
2019BEME055	Umme Hani N	P	0	0	0	7	0	0	7	6	20	Understand
2019BEME028	Subramanian V	P	0	0	0	4	0	0	2	0	6	Understand
2019BEMEN03	Akshay	P	0	0	4	5	7	2	0	0	18	Evaluate
2019BEMEN06	Deepal Gowda M	P	0	0	2	0	2	2	0	0	6	No Level
2019BEME047	Suhas Devanga H K	P	9	5	0	0	5	2	0	0	21	Understand
2019BEME062	Yashaswini T P	P	0	0	1	8	4	1	2	6	17	Understand
2019BEME024	Rakshith Gowda G S	P	0	0	0	5	0	0	4	0	9	Understand
2019BEME056	Varsha H C	P	10	1	0	0	0	0	9	6	26	Understand
2019BEME041	Sathvik S A	P	0	0	7	8	9	2	0	0	26	Evaluate
2019BEMEN14	Madan K.n	P	0	0	0	8	0	0	0	0	8	Understand
2019BEME037	Ruchitha M.V	P	0	0	0	7	0	6	8	0	15	Understand
2019BEME063	Shashank K R	P	10	5	0	0	9	6	0	0	30	Understand
2019BEME046	Sindhushree C N	P	10	3	0	0	0	0	9	0	22	Understand
2019BEME048	Sunil R	P	3	2	0	0	3	1	0	0	9	No Level
2019BEME051	Tejas	P	0	0	0	2	3	0	0	0	5	No Level
2019BEME061	Vijay A S	P	0	0	0	4	8	3	0	0	15	Understand
2019BEME032	Varun M S	P	7	5	0	0	7	3	0	0	22	Understand
2019BEMEN07	Ganeshchar B	P	0	0	2	0	2	0	0	0	4	No Level
2019BEMEN12	Lohith K.h	P	4	0	0	0	3	0	0	0	7	No Level
2019BEME053	Thejaswini K.r	P	10	5	0	0	9	6	0	6	30	Understand

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USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
2019BEME025	Rakshithgowda B	P	0	0	0	6	5	2	0	0	13	Understand
2019BEMEN09	Kiran B	P	2	0	0	0	0	0	2	3	7	Understand
2019BEME018	Mohankumar G.t	P	0	0	1	8	0	0	6	0	15	Understand
2019BEME026	Ravikumar C.p	P	0	0	0	7	4	1	0	0	12	Understand
2019BEME045	Sinchana C	P	3	0	0	8	0	0	9	5	22	Understand
2019BEME038	Sagar S.r	P	0	0	0	7	3	1	0	0	11	Understand
2019BEME057	Varshini J	P	6	0	0	8	6	2	0	0	16	Understand
2019BEME042	Shravya J.m	P	10	5	0	0	9	6	0	0	30	Understand
2019BEMEN11	Likhith S.j	P	0	0	0	0	0	0	0	0	0	No Level
2019BEMEN10	Kiran Gowda H K	P	10	0	0	0	2	3	0	0	15	Understand
2019BEME015	Manjunath B	P	10	4	0	0	7	0	0	0	21	Understand
2019BEMEN02	Akash M	Ab	0	0	0	0	0	0	0	0	0	No Level
2019BEME050	Suvin T.s	P	0	0	0	7	1	0	0	0	8	Understand
2019BEME060	Vidyashree M	P	0	0	7	7	0	0	7	1	22	Evaluate
2019BEME022	Omkar A	P	0	0	0	0	4	1	0	0	5	No Level
2019BEMEN13	Lokesh N M	P	0	0	0	5	2	0	0	0	7	Understand
2019BEME029	Sudeep D.c	P	0	0	0	6	3	3	0	0	12	Understand
2019BEME039	Sangeetha C.k	P	0	1	2	0	1	3	8	0	10	Understand
2019BEME019	Namithgowda D R	P	10	5	0	0	9	6	0	0	30	Understand
2019BEME044	Sinchana B P	P	0	0	3	8	0	6	9	6	26	Understand
2019BEME052	Thejas A	P	0	0	0	8	7	2	0	0	17	Understand
2019BEMEN05	Darshan B.g	P	0	0	2	1	3	6	8	0	12	Understand
2019BEME036	Revanth N.R	P	0	0	0	6	2	0	0	0	8	Understand
2019BEMEN08	Jeevitha M T	P	6	0	4	7	0	0	9	0	20	Evaluate
2019BEME040	Saniya Saba	P	4	0	4	8	0	0	7	5	24	Evaluate
2019BEMEN01	Ajay A.c	P	0	0	5	5	7	2	0	0	19	Evaluate
2019BEME054	Thrupthi M N	P	0	0	2	8	4	6	0	0	20	Understand
2019BEMEN04	Bahuguna V	P	0	0	4	3	0	0	0	0	7	Evaluate
2019BEME027	Sinchana Aradhya S B	P	0	0	7	8	9	6	0	0	30	Evaluate
2019BEME020	Nandan B S	P	0	0	1	5	0	0	0	0	6	Understand
2019BEME059	Vidya R Gowda	P	8	5	0	0	0	0	9	6	28	Understand
2019BEME021	Nikhil Gowda H N	P	0	0	0	7	2	0	0	0	9	Understand
2019BEME017	Mohammed Shahid Pasha	P	0	0	0	2	0	0	3	0	5	No Level
2019BEME049	Susheelkumar H S	P	0	0	1	7	1	0	0	0	9	Understand
2019BEME033	Vinay M	P	5	0	1	8	4	2	0	0	15	Understand
2019BEME016	Manoj P	P	0	0	3	0	1	0	0	0	4	No Level

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Answer any 1 questions					
Q.No			Max Marks	CO	BT/ CL
3	a	Compare 2 stroke and 4 stroke engine?	9	123	L2
3	b	What are the properties of good refrigerant ?	6	123	L2
4	a	With suitable sketch explain the working of vapor absorption refrigeration system	9	123	L2
4	b	Explain the following: (i)refrigeration effect (ii) Ton of Refrigeration (iii) COP	6	123	L2

Evaluation

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
2019BEME035	Rakshith N.g	P	10	5	0	0	5	6	0	0	26	Understand
2019BEME043	Shubha Khadri L	P	8	4	0	0	7	6	0	0	25	Understand
2019BEME058	Vibha B	P	10	5	0	0	0	0	9	6	30	Understand
2019BEME023	Pavankumar C G	P	0	0	0	0	2	0	0	0	2	No Level
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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6 . Course Information

6 . 4 Internal Assessment

Internal : 1

Date : 05/10/2019

Semester:1-CBCS 2018

Time : 09:30 - 10:30

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18ME15)

Max Marks: 30

Faculty : Nishchitha K M

Part A					
Answer any 1 questions					
Q.No			**Max Marks**	**CO**	**BT/ CL**
1	a	a) Explain with neat sketch, impulse and reaction turbine.	10	1	L2
1	b	Compare impulse and reaction turbine	5	1	L2
2	a	a) a single cylinder 4stroke diesel engine the following results while running at full load. Area of indicator card 300 mm2 , length of diagram 40mm, spring constant 1 bar/mm, speed of the engine 400rpm, load on the brake 370N, spring balance reading 50N, diameter of brake drum 1.2m, fuel consumption 2.8 kg/hr, CV of fuel 41800 kJ /kg, diameter of the cylinder 160mm, stroke of the piston 200mm, determine the following: (a) IMEP (b) BMEP (c)BP (d) BSFC (e) Brake thermal & indicated thermal efficiencies.	7	123	L5
2	b	Explain the classification of IC Engine?	8	123	L2

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Evaluation

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3	Q4	IA Total	BT/CL
			a	b	a	b	a	a		
2019BEME035	Rakshith N.g	Ab	0	0	0	0	0	0	0	No Level
2019BEME043	Shubha Khadri L	P	0	0	7	8	10	0	25	Understand
2019BEME058	Vibha B	Ab	0	0	0	0	0	0	0	No Level
2019BEME023	Pavankumar C G	P	0	0	6	6	0	6	18	Understand
2019BEME031	Varun K.s	P	0	0	0	0	0	9	9	Understand
2019BEME030	Surajprasad R	P	0	0	0	0	0	0	0	No Level
2019BEME025	Rakshithgowda B	P	0	0	5	6	8	0	19	Understand
2019BEMEN09	Kiran B	P	0	0	7	8	0	10	25	Understand
2019BEME018	Mohankumar G.t	P	0	0	7	6	8	0	21	Understand
2019BEME026	Ravikumar C.p	P	8	0	0	0	13	0	21	Understand
2019BEME045	Sinchana C	P	0	0	7	7	0	12	26	Understand
2019BEME038	Sagar S.r	P	0	0	5	8	0	15	28	Understand
2019BEME057	Varshini J	Ab	0	0	0	0	0	0	0	No Level
2019BEME042	Shravya J.m	Ab	0	0	0	0	0	0	0	No Level
2019BEMEN11	Likhith S.j	P	12	3	0	5	0	0	15	Understand
2019BEMEN10	Kiran Gowda H K	P	12	0	0	0	0	0	12	Understand
2019BEME015	Manjunath B	P	0	0	6	8	15	0	29	Understand
2019BEMEN02	Akash M	P	12	0	0	0	12	0	24	Understand
2019BEME050	Suvin T.s	P	0	0	6	8	7	0	21	Understand
2019BEME060	Vidyashree M	P	0	0	3	8	15	0	26	Understand
2019BEME022	Omkar A	P	12	0	6	6	12	0	24	Understand
2019BEMEN13	Lokesh N M	P	8	0	0	0	6	0	14	Understand
2019BEME029	Sudeep D.c	P	0	0	6	4	3	0	13	Understand
2019BEME039	Sangeetha C.k	P	12	0	0	0	0	12	24	Understand
2019BEME019	Namithgowda D R	Ab	0	0	0	0	0	0	0	No Level
2019BEME044	Sinchana B P	P	0	0	7	8	0	15	30	Understand
2019BEME052	Thejas A	P	12	0	0	0	0	0	12	Understand
2019BEMEN05	Darshan B.g	P	12	0	0	0	0	0	12	Understand
2019BEME036	Revanth N.R	Ab	0	0	0	0	0	0	0	No Level
2019BEMEN08	Jeevitha M T	P	0	0	7	8	8	8	23	Understand

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2019BEME040	Saniya Saba	Ab	0	0	0	0	0	0	0	No Level
2019BEMEN01	Ajay A c	P	0	0	7	8	0	12	27	Understand
2019BEME054	Thrupthi M N	P	10	0	0	0	0	0	10	Understand
2019BEMEN04	Bahuguna V	P	0	0	2	8	0	0	10	Understand
2019BEME027	Sinchana Aradhya S B	P	12	3	0	0	0	15	30	Understand
2019BEME020	Nandan B S	P	3	0	0	0	3	0	6	No Level
2019BEME059	Vidya R Gowda	Ab	0	0	0	0	0	0	0	No Level
2019BEME021	Nikhil Gowda H N	P	10	0	0	0	4	8	18	Understand
2019BEME017	Mohammed Shahid Pasha	P	12	0	0	0	0	0	12	Understand
2019BEME049	Susheelkumar H S	P	0	0	5	7	0	10	22	Understand
2019BEME033	Vinay M	P	0	0	6	6	2	0	14	Understand
2019BEME016	Manoj P	P	12	0	0	0	0	4	16	Understand
2019BEME034	Nayana R	Ab	0	0	0	0	0	0	0	No Level
2019BEME055	Umme Hani N	Ab	0	0	0	0	0	0	0	No Level
2019BEME028	Subramanian V	P	7	0	0	0	6	0	13	Understand
2019BEMEN03	Akshay	Ab	0	0	0	0	0	0	0	No Level
2019BEMEN06	Deepal Gowda M	P	12	1	0	0	1	0	14	Understand
2019BEME047	Suhas Devanga H K	P	12	3	0	0	15	0	30	Understand
2019BEME062	Yashaswini T P	P	12	0	0	3	9	0	21	Understand
2019BEME024	Rakshith Gowda G S	P	0	0	5	8	0	0	13	Understand
2019BEME056	Varsha H C	P	0	0	7	8	15	0	30	Understand
2019BEME041	Sathvik S A	Ab	0	0	0	0	0	0	0	No Level
2019BEMEN14	Madan K.n	P	0	0	7	0	0	0	7	Understand
2019BEME037	Ruchitha M.V	P	0	0	7	8	0	15	30	Understand
2019BEME063	Shashank K R	P	0	0	0	0	0	4	4	No Level
2019BEME046	Sindhushree C N	Ab	0	0	0	0	0	0	0	No Level
2019BEME048	Sunil R	P	10	0	0	0	2	0	12	Understand
2019BEME051	Tejas	P	7	3	0	0	1	0	11	Understand
2019BEME061	Vijay A S	P	0	0	7	8	0	15	30	Understand
2019BEME032	Varun M S	Ab	0	0	0	0	0	0	0	No Level
2019BEMEN07	Ganeshchar B	P	5	2	0	0	0	0	7	Understand
2019BEMEN12	Lohith K.h	P	10	0	0	0	3	0	13	Understand

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(odd) 2019-2020

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
18EME15	**Elements of Mechanical Engineering**	HC	3	1	0	4	4

Prerequisites: Basic Physics	Internal Assessment	Semester End Exam
	40 Marks	60 Marks

Course Objectives:

Students belonging to different disciplines of Engineering are made to learn few fundamental topics related to Mechanical Engineering systems.

Course Outcomes:

On successful completion of this course, the student shall be able to:

- Develop the basic knowledge of Energy sources, Boilers, IC engines and Refrigeration & Air conditioning systems.
- Understand the various Machine tools, Metal joining processes, Power transmission systems and Bearings & Lubrication systems.
- Understand the applications of various Engineering & Composite materials.

Course Content:

::MODULE – 1: (10 Hours)

Energy Sources & Boilers:

Energy Sources: Introduction; Types & Examples; Solar Power Plant, Hydroelectric Power Plant & Wind Power Plant.

Steam: Steam formation; Steam properties–Dryness fraction, Sensible heat, Latent heat, Total heat, Specific volume & Internal energy; Types of Steam (No numerical problems).

Boilers: Introduction; Classification; List & Functions of Boiler Mountings & Accessories (No constructional details). [*Self Study: Babcock & Wilcox Boiler*] **Turbines:**

Steam Turbines: Introduction; Working Principle of Impulse & Reaction Turbines.

Gas Turbines: Introduction; Working Principle of Open and Closed cycle Gas Turbines.

Hydraulic Turbines: Introduction; Working Principle of Pelton and Kaplan Turbines.

::MODULE – 2:: (10 Hours)

Internal Combustion Engines:

Introduction; Classification; Parts; Terminology; P-V Diagrams of Otto and Diesel Cycles; Simple Numerical Problems on Indicated Power, Brake Power, Mechanical Efficiency, Indicated Thermal Efficiency and Brake Thermal Efficiency. [*Self Study: Working of 2-Stroke & 4-Stroke IC Engines*]

Refrigeration & Air conditioning:

Introduction; Definitions – Refrigerating Effect, Ton of Refrigeration, Unit of Refrigeration, Coefficient of Performance (COP); Refrigerants – Properties & Commonly Used; Principle and Working of Vapour Compression and Vapour Absorption Refrigerators; Introduction to Air conditioning; Working Principle of Domestic Air Conditioner.

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::MODULE – 3:: (10 Hours)

Machine Tools:
Turning Machine: Parts; Classification and Operations performed (Turning, Taper turning, Facing, Knurling, Thread cutting).
Drilling Machine: Working Principle of Drilling; Classification and Operations performed (Boring, Reaming, Tapping, Counter Sinking & Counter Boring).
Grinding Machine: Working Principle of Grinding; Working Operation of Surface Grinding, Cylindrical Grinding &Centuries Grinding.
Metal Joining Processes:
Welding: Definition; Classification; Advantages; Disadvantages; Applications; Brief Discussion on Electric Arc Welding & Oxy-Acetylene Gas Welding; Types of Gas Flames.
Soldering: Definition; Applications; Working Principle; Types of Solder.
Brazing: Definition; Applications; Working Principle; Comparison of Welding, Soldering & Brazing.

::MODULE – 4:: (10 Hours)

Power Transmission:
Belt Drives: Types (Open & Crossed); Definitions–Velocity Ratio, Creep, Slip.
Pulley Drives: Types (Idler, Stepped Cone and Fast & Loose).
Gear Drives: Introduction; Types of Gear Train. [Simple Numerical Problems] **Bearings & Lubrication:**
Bearings: Introduction; Types–Ball & Roller Bearings.
Lubrication: Definition; Purposes; Types–Drop Feed & Splash; Types & Properties of Lubricants.

::MODULE – 5:: (10 Hours)

Engineering Materials:
Introduction; Types and Applications of Ferrous & Non-Ferrous Metals and Alloys; Ceramics and Polymers.
Composite Materials:
Introduction; Classification; Advantages; Limitations; Industrial Applications.

Text Books:

- K. R. Gopalakrishna, Sudhir Gopalakrishna, S. C. Sharma, "Text Book of Elements of Mechanical Engineering", Subhas Publications, 2015.
- S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology – Vol-1&2", Media Promoters & Publishers Pvt. Ltd., 2010.

Reference Books:

- S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", IK International Publishing Pvt. Ltd., 2010.
- Kestoor Praveen & Ramesh, "Elements of Mechanical Engineering", Suggi Publishing, 2015.
- K. V. A. Balaji & K. Ramashastry, "Elements of Mechanical Engineering Sciences", Sanguine Technical Publishers, 2006.

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USN | | | | | | | | | | |

18ME15/25

Model Question Paper

First Semester B.E. Degree (CBCS) Examination

Elements of Mechanical Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1.Answer any FIVE full questions, choosing one full question from each module.
2. Use of steam tables is permitted.

MODULE – I

1 a Classifydifferent sources of energy with suitable examples. (04 Marks)

b Find the enthalpy of 1kg of steam at 12 bar when (i) steam is dry saturated (ii) steam is 22% wet (iii) superheated to 250°C. Take the specific heat of superheated steam as 2.25kJ/kgK. (06 Marks)

c With the help of T-h diagram, explain the generation of steam at constant pressure. (10 Marks)

OR

2 a Write short note on (i) global warming (ii) Ozone depletion (10 Marks)

b State and Explain Zeroth law, first law and second law of thermodynamics. (10 Marks)

MODULE – II

3 a With a neat sketch, explain the working of water tube boiler. (10 Marks)

b Classify Hydraulic pumps and explain the working principle of centrifugalpump with a neat sketch. (10 Marks)

OR

4 a Classify hydraulic turbines and with a neat sketch explain the working of Francis turbine. (10 Marks)

b Explain the functions of (i) Water level indicator (ii) Safety valve (iii) Super heater (iv) Pressure gauge (v) Feed check valve (10 Marks)

MODULE – III

5 a With the help of P-V diagram, explain the operation of 4-Stroke Petrol engine (10 Marks)

b Following data are collected from a 4-stroke, single cylinder at full load. Bore = 200mm, stroke= 280mm, speed = 300 rpm, Indicated mean effective pressure = 5.6bar, Torque on the brake drum = 250 N-m, fuel consumed = 4.2kg/hour, and calorific value of fuel = 41000 KJ/kg.Determine (i) Brake power (ii) Mechanical Efficiency (iii) Indicated thermal efficiency (iv) Brake thermal efficiency (10 Marks)

OR

a Define the following refrigeration terms :
i) Refrigerant ii) Ton of refrigeration iii) COP iv) Relative COP v) Refrigerating effect (05 Marks)

b Define refrigeration. State the application of refrigeration (05 Marks)

c With the help of a flow diagram, explain the functioning of Vapor Compression refrigeration cycle. (10 Marks)

...of equations written e.g, 38+2 = ..., will be treated as malpractice.

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MODULE – IV

7 a Classify and explain various types of Steel (10 Marks)

b With a neat sketch explain the Arc welding method. (10 Marks)

OR

8 a Derive an expression for length of belt in open belt drive. (10 Marks)

b A shaft running at 100 rpm, is to drive a parallel shaft at 150 rpm. The pulley on the driving shaft is 350 mm in diameter. Find the diameter of the driven pulley. Calculate the linear velocity of the belt and the velocity ratio. (10Marks)

MODULE – V

9 a Explain the following machining operations on Lathe machine with suitable sketches (i) Turning (ii) Facing (iii) Thread cutting (iv) Knurling (10 Marks)

b With a neat sketch explain the working of vertical milling machine (10 Marks)

OR

10 a Explain the advantages and applications of robots in industries. (10Marks)

b Discuss the elements of a CNC system with a neat block diagram. (10 Marks)

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BGSIT BG Nagara	Doc. Title: Internal Test Question Paper		Doc. No.: 06#Form#02b
	Page 1 of 1	Date: 05.10.2019	Rev. No. 00

Internal Test Question Paper Format – CBCS Scheme (VTU)

Name of the Faculty/s: NISHCHITHA K.M

Date: 02.10.19 Signature:

Reviewer's Signature:

NOTE: Only the following information is to be given to the students.

BGS Institute of Technology

Department: Mechanical Engineering

Test: I

Semester: IV

Subject Name & Code: ~~Manufacturing~~ Process 1(18ME15)

USN: 4BW

Instructions

Duration: 60 minutes

Max. Marks: 30

i) Select one question from each part.

ii) All questions carry equal marks.

Question Number	Questions	Marks	CO	Levels
	PART – A			
1	a) Explain with neat sketch, impulse and reaction turbine.	10	C01	L2
	b) Compare impulse and reaction turbine.	5	C01	L2
	OR			
2	**a) a single cylinder 4stroke diesel engine the following results while running at full load. Area of indicator card 300 mm^2, length of diagram 40mm, spring constant 1 bar/mm, speed of the engine 400rpm, load on the brake 370N, spring balance reading 50N, diameter of brake drum 1.2m, fuel consumption 2.8 kg/hr, CV of fuel 41800 kJ/kg, diameter of the cylinder 160mm, stroke of the piston 200mm, determine the following: (a) IMEP (b) BMEP (c)BP (d) BSFC (e) Brake thermal & indicated thermal efficiencies.**	7	C02	L4
	b) Explain the classification of IC Engine?	8	C02	L2
	PART – B			
3	a) Compare 2 stroke and 4 stroke engine?	5	C02	L2
	b) What are the properties of good refrigerant ?	6	C02	L2
	OR			
4	With suitable sketch explain the working of vapor absorption refrigeration system.	9	C03	L2
	b) Explain the following: (i)refrigeration effect (ii) Ton of Refrigeration (iii) COP	8	C03	L2

Note: The Choice question should satisfy same COs and levels.

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BGS Institute of Technology

Department: Mechanical Engineering

Test: I

USN: 4BW

Semester: III **Date**: 05/10/2019

Subject Name & Code: Manufacturing Process EME

Instructions

Duration: 60 minutes Max. Marks: 30

i) Select one question from each part.

ii) All questions carry equal marks.

Question Number	Questions	Marks	CO	Levels
	PART – A			
1	a) Explain with neat sketch, impulse and reaction turbine.	10	C01	L2
	b) Compare impulse and reaction turbine.	5	C01	L2
	OR			
2	**a) a single cylinder 4stroke diesel engine the following results while running at full load. Area of indicator card 300 mm^2, length of diagram 40mm, spring constant 1 bar/mm, speed of the engine 400rpm, load on the brake 370N, spring balance reading 50N, diameter of brake drum 1.2m, fuel consumption 2.8 kg/hr, CV of fuel 41800 kJ/kg, diameter of the cylinder 160mm, stroke of the piston 200mm, determine the following: (a) IMEP (b) BMEP (c)BP (d) BSFC (e) Brake thermal & indicated thermal efficiencies.**	7	C02	L4
	b) Explain the classification of IC Engine?	8	C02	L2
	PART – B			
3	a) Compare 2 stroke and 4 stroke engine?	5	C02	L2
	b) What are the properties of good refrigerant ?	6	C02	L2
	OR			
4	With suitable sketch explain the working of vapor absorption refrigeration system.	9	C03	L2
	b) Explain the following: (i)refrigeration effect (ii) Ton of Refrigeration (iii) COP	8	C03	L2

Signature of Staff **Signature of HOD**

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USN :

BGS Institute of Technology, Mandya
DEPARTMENT OF CHEMISTRY
I - INTERNAL ASSESSMENT

Semester: 1-CBCS 2018
Subject: ELEMENTS OF MECHANICAL ENGINEERING (18ME15)
Faculty: Ms Nishchitha K M

Date: 5 Oct 2019
Time: 09:30 AM - 10:30 AM
Max Marks: 30

Instructions to Students :

Duration: 60 minutes — Max. Marks: 30

1. Select one question from each part.
2. All questions carry equal marks.

PART A

Answer any1 question(s)

Q.No			Marks	CO	BT/C
1	a	a) Explain with neat sketch, impulse and reaction turbine.	10	CO1	L2
	b	Compare impulse and reaction turbine	5	CO1	L2
2	a	**a) a single cylinder 4stroke diesel engine the following results while running at full load. Area of indicator card 300 mm2 , length of diagram 40mm, spring constant 1 bar/mm, speed of the engine 400rpm, load on the brake 370N, spring balance reading 50N, diameter of brake drum 1.2m, fuel consumption 2.8 kg/hr, CV of fuel 41800 kJ/kg, diameter of the cylinder 160mm, stroke of the piston 200mm, determine the following: (a) IMEP (b) BMEP (c)BP (d) BSFC (e) Brake thermal & indicated thermal efficiencies.**	7	CO1,CO2,CO3	L5
	b	Explain the classification of IC Engine?	8	CO1,CO2,CO3	L2

PART B

Answer any1 question(s)

Q.No			Marks	CO	BT/C
3	a	Compare 2 stroke and 4 stroke engine?	9	CO1,CO2,CO3	L2
	b	What are the properties of good refrigerant ?	6	CO1,CO2,CO3	L2
4	a	With suitable sketch explain the working of vapor absorption refrigeration system	9	CO1,CO2,CO3	L2
	b	Explain the following: (i)refrigeration effect (ii) Ton of Refrigeration (iii) COP	6	CO1,CO2,CO3	L2

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution – 1st Test

Semester: 1st　　Date: 1/10/19

Subject Title: Elements of Mechanical Engineering　　Subject Code: 18EME15

Question Number	Solution	Marks Allocated
1(a)	~~Diagram~~ Impulse turbine Diagram – 2 Marks Explanation – 3M Reaction turbine Diagram – 2M Explanation – 3M 2+3=5 2+3=5	10M
(b)	5 comparesition each carries one marks 5×1=5	5M
2(a)	P_m = IMEP = 7.5 Bar – 2M BMEP = P_{mb} = 6.03 Bar – 2M BSFC = 0.348 kg/k-w-hr – 1M η_{BTH} = 24.7% – 1M η_{ITH} = 30.79% – 1M with solution. 7×1=7 2+2+1+1+1=7	7M

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Question Number	Solution	Marks Allocated
2(b)	Classification of IC engine with explanation. (1) According to the type fuel used fuel (a) PE (b) DE (c) GE (d) BE (2) According to the method of ignition (a) SI (b) CI (3) The Number stroke per cycle (a) 2-stroke (b) 4-stroke (4) The cycle of combustion (a) Otto (b) Diesel (c) Dual. (5) Number of cylinders. (a) Single (b) Multi (6) Arrangement of cylinders (a) VE (b) HE (c) IE (d) RE (e) V-engine (f) opp-engine. (7) Method of cooling (a) Water (b) Air (8) Uses. (a) SE (b) AE (c) ME (d) ACE. 8x1=8	8M

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Question Number	Solution	Marks Allocated
	called as capity of refrigerator and is expressed in KJ/sec or KW. (ii) Ton of Refrigeration : the capacity of a refrigerator can be expressed in terms of ton of refrigeration, which is also the unit of refrigeration. (iii) COP : the performance of a refrigerator is measured by a factor known as coefficient of performance, simply termed as COP. $COP = \frac{\text{amount of heat removed}}{\text{work supplied}}$ $COP = \frac{Q}{W}$ each carries 2 marks. $2 \times 3 = 6$ 21/10/2019.	6M

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Question Number	Solution	Marks Allocated
3(a)	2 stroke 4 stroke → → → → ⋮ 9 points each carries one mark. 9×1 = 9	9M.
3(b)	Thermal properties. → → → Chemical properties → → → Physical properties → → → others. 6×1 = 6	6M.
4(a)	Vapour absorption refrigeration system Diagram - 3M Construction - 3M Working - 3M 3+3+3 = 9	9M.
4(b)	Explain the following (i) refrigeration effect: the amount of cooling produced by the refrigeration process is known as refrigerating effect. In other words, it can be defined as the rate at which heat is removed from the system in one cycle of operation. Refrigerating effect is also	

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USN :

BGS Institute of Technology, Mandya
DEPARTMENT OF CHEMISTRY
II - INTERNAL ASSESSMENT

Semester: 1-CBCS 2018
Subject: ELEMENTS OF MECHANICAL ENGINEERING (18ME15)
Faculty: Ms Nishchitha K M

Date: 6 Nov 2019
Time: 11:00 AM - 12:00 PM
Max Marks: 30

PART A

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
1	a	with neat sketches , explain following opearations? a)facing b)turnng c) knurling d) reaming e) counter boring	15	CO1,CO2,CO3	L2
2	a	with neat sketch explain working principle and constructional features of centerless grinding machine	8	CO1,CO2,CO3	L2
	b	sketch and explain oxy-acetylene welding?	7	CO1,CO2,CO3	L2

PART B

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
3	a	what is welding? explain electric arc welding with a neat sketch	9	CO2,CO3	L2
	b	distinguish between brazing and welding	6	CO2,CO3	L2
4	a	explain the properties of lubricants	7	CO2,CO3	L2
	b	with neat diagram explain the follwing lubricators a)drop feed lubricator b)splash lubrication	8	CO2,CO3	L2

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USN :

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Faculty: Ms Nishchitha K M

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PART A

Answer any1 question(s)

Q.No			Marks	CO	BT/(
1	a	with neat sketches , explain following opearations? a)facing b)turnng c) knurling d) reaming e) counter boring	15	CO1,CO2,CO3	L2
2	a	with neat sketch explain working principle and constructional features of centerless grinding machine	8	CO1,CO2,CO3	L2
	b	sketch and explain oxy-acetylene welding?	7	CO1,CO2,CO3	L2

PART B

Answer any1 question(s)

Q.No			Marks	CO	BT/(
3	a	what is welding? explain electric arc welding with a neat sketch	9	CO2,CO3	L2
	b	distinguish between brazing and welding	6	CO2,CO3	L2
4	a	explain the properties of lubricants	7	CO2,CO3	L2
	b	with neat diagram explain the follwing lubricators a)drop feed lubricator b)splash lubrication	8	CO2,CO3	L2

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution – Test 1 Date: 09.11.19

Semester: V Subject Title: MPT EME Subject Code: 18MEI5

Question Number	Solution	Marks Allocated
1	a) Facing – Diagram 1.5 Explanation 1.5 ⓐ ⓑ ⓒ 3m b) turning – Diagram 1.5 Explanation 1.5 ⓐ ⓑ ⓒ 3m. c) Knurling – Diagram 1.5 Explanation 1.5 3m. d) Reaming – Diagram 1.5 Explanation 1.5 3m. e) Counter boring – Diagram 1.5 Explanation 1.5. 3m.	15m
2	a) Sketch : 3m. Construction : 2.5 m Working : 2.5m 8m	8 m

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Question Number	Solution	Marks Allocated
2)	b) Sketch – 3m Construction – 2m Working – 2m 7m	7m
3a)	a) Welding - defn – 1 m Sketch – 3 m Construction – 2.5 m Working – 2.5 m	9m
	b) Brazing (Vs) Welding Comparision Minimum 6 difference. Each Carries 1m.	6m.
4.	a) Lubricant – Properties. – Viscosity – Flash point – Fire point – Pour point – Volatility – Oiliness – Physical Stability – Resistance against Corrosion. } Explanation. 7 x 1. 7m	7m.
	b) Drop feed Lubricator. – Diag. – 2 m Explanat – 2m. Splash lubricator – Diagram. – 2m – Explanation – 2m	8m.

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution - Test - 2 Date: 09.11.19

Semester: I Subject Title: EME Subject Code: 18 ME15

Question Number	Solution	Marks Allocated
1	a) Facing — Diagram 1.5, Explanation 1.5 (ⓐ ⓑ ⓒ) — 3m b) turning - Diagram 1.5, Explanation 1.5 (ⓐ ⓑ ⓒ) — 3m. c) Knurling - Diagram 1.5, Explanation 1.5 — 3m. d) Reaming - Diagram 1.5, Explanation 1.5 — 3m. e) Counter boring - Diagram 1.5, Explanation 1.5. — 3m.	15m
2	a) Sketch : 3m. Construction : 2.5 m Working : 2.5m 8m	8 m

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Question Number	Solution	Marks Allocated
2)	b) Sketch – 3m Construction – 2m Working – 2m 7m	7m
3a)	a) Welding - def^n – 1 m Sketch – 3 m Construction – 2.5m Working – 2.5m	9m
	b) Brazing (Vs) Welding Comparission Minimum 6 difference. Each Carries 1m.	6m.
4.	a) Lubricant – Properties. - Viscosity - Flash point - Fire point - Pour point - Volatility - Oiliness - Physical stability - Resistance against Corrosion. } Explanation. 7 × 1.7m	7m.
	b) Drop feed Lubricator. – Diag. – 2m Explanat – 2m Splash lubricator – Diagram. – 2m – Explanation – 2m	8m.

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12/5/2019

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USN :

DEPARTMENT OF CHEMISTRY
III - INTERNAL ASSESSMENT

Semester: 1-CBCS 2018
Subject: ELEMENTS OF MECHANICAL ENGINEERING (18ME15)
Faculty:

Date: 9 Dec 2019
Time: 11:00 AM - 12:00 PM
Max Marks: 30

Instructions to Students :

Answer any one question from each part

PART A

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
1	a	Explain the types of belt-drive with neat sketch, mention its advantageas and dis-advantages.	12	CO3	L2
	b	Explain the trminologies in belt drive.	3	CO3	L2
2	a	Give brief classification on ferrous and non ferrous metals.	7	CO3	L2
	b	Explain the following, a)Pig Iron b)wrought Iron c)white cast iron d)ductile cast iron	8	CO3	L2

PART B

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
3	a	What are the types of steels, list its applications.	15	CO3	L2
4	a	What is composite?What is the classification of composites?explain.	15	CO3	L2

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution – TEST – 3 Date:

Semester: I Subject Title: Elements of Mechanical Engg Subject Code: 18EME15

Question Number	Solution	Marks Allocated
1. a)	Types of Belt-drive – 4 Sketch – 4 advantages – 4	12
2 b)	terminologies in Belt drive.	3.
2. a)	classification on ferrous. 3.5 classification on Non-ferrous 3.5	3.5 07
b)	Pig Iron < ① ② 2m Wrought Iron < ① ② 2m White cast Iron < ① ② 2m ductile Cast Iron < ① ② 2m.	8m

Question Number	Solution	Marks Allocated
3.		
a)	Types of steel. - 10	
	Application - 5	
		15m
4		
a)	Composite def^n :	
	classification. 5	
	Explanation	

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|| Jai Sri Gurudev ||

Adichunchanagiri Shikshana Trust (R)

BGS INSTITUTE OF TECHNOLOGY

Department of Mechanical Engineering

CO-PO & CO-PSO mapping (18 Scheme)

Programme	Course Code	Subject	Credits	L-T-P-TL	Assessment		Exam Duration
					SEE	CIA	
B.E	18ME15/ 25	Elements Of Mechanical Engineering	04	3-2-0-5	60	40	3Hrs

Co's

18C112.1	Develop the basic knowledge of Energy sources, Boilers, IC engines and Refrigeration & Air conditioning systems.
18C112.2	Understand the various Machine tools, Metal joining processes, Power transmission systems and Bearings & Lubrication systems.
18C112.3	Understand the applications of various Engineering & Composite materials.

PO & PSO's

PSO-1: Ability to acquire competencies in designing, analyzing and evaluating the mechanical components.

PSO-2: Ability to work professionally by applying manufacturing and management practices.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
18C112.1	2	2	1			1	1					1	1	1
18C112.2	2	2				1	1					1	1	1
18C112.3	2						1					1	1	1
AVG	2	2	1			1	1					1	1	1

Course Owner

HOD
Dept. of Pre Engineering
BGS Institute of Technology
B G Nagara- 571448
Nagamangala Taluk, Mandya District.

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Subject Name & Code	Elements of Mechanical Engineering	15EME 24
Semester	2	2019-20
Faculty Name:	Mrs. NISHCHITHA KM	

	CIE (%)	SEE (%)	CES (%)	
COs	60	30	10	TOTAL
CO1	2.95	0.00	2.33	2.00
CO2	2.82	0.00	2.31	1.92
CO3	2.95	0.00	2.38	2.01

CO-PO/PSO Mapping Table

PO/PSO	Total	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2.00	2	2	1			1	1					1	1	1
CO2	1.92	2	2				1	1					1	1	1
CO3	2.01	2						1					1	1	1
Sum		6	4	1	0	0	2	3	0	0	0	0	3	3	3
Number		3	2	1	0	0	2	3	0	0	0	0	3	3	3
Average		2	2	1	0	0	1	1	0	0	0	0	1	1	1
Weighted Sum		11.86556	7.855461	2.004912	0	0	3.927731	5.932781	0	0	0	0	5.932781	5.9327812	5.932781
PO Attainment		1.32	1.31	0.67	0.00	0.00	0.65	0.66	0.00	0.00	0.00	0.00	0.66	0.66	0.66

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BGS Institute of Technology
Department of Chemistry (CHE)

1 . Academic calendar 2019-20 (Semester 2)

Date	Day	Event
10 Feb 2020	MONDAY	Term Start Date
10 Feb 2020	MONDAY	Commencement of Even Semester Classes
19 Mar 2020	THURSDAY	1st IA Test
20 Mar 2020	FRIDAY	1st IA Test
21 Mar 2020	SATURDAY	1st IA Test
27 Mar 2020	FRIDAY	1st IA Progress report dispatch
27 Mar 2020	FRIDAY	Test 1 Progress Report dispatch
28 Mar 2020	SATURDAY	Class Teachers Meeting
20 Apr 2020	MONDAY	2nd IA Test
21 Apr 2020	TUESDAY	2nd IA Test
22 Apr 2020	WEDNESDAY	2nd IA Test
29 Apr 2020	WEDNESDAY	Test 2 Progress Report dispatch\t
30 Apr 2020	THURSDAY	Class Teachers Meeting
21 May 2020	THURSDAY	3 IA TEST
22 May 2020	FRIDAY	3 IA TEST
23 May 2020	SATURDAY	3 IA TEST
1 Jun 2020	MONDAY	Last Working Day
8 Jun 2020	MONDAY	Test 3 Progress Report dispatch
13 Jun 2020	SATURDAY	Last Working Day\t
31 Jul 2020	FRIDAY	Term End Date

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BGS Institute of Technology

Department of Chemistry (CHE)

2 . Timetable

	1	2	3	4		5	6	7
	09:00 AM 09:55 AM	09:55 AM 10:50 AM	11:00 AM 11:55 AM	11:55 AM 12:50 PM	12:50 PM 01:45 PM	01:45 PM 02:35 PM	02:35 PM 03:25 PM	03:25 PM 04:15 PM
MON			BE 17ME655 ME Semester 6 A					
TUE	BE 18EME25 CHE Semester 2 C	BE 18MEL47B ME Semester 4 A						BE 18EME25 CHE Semester 2 C
WED			BE 18EME25 CHE Semester 2 C					
THU		BE 18MEL47A ME Semester 4 A		BE 17ME655 ME Semester 6 A				
FRI		BE 18EME25 CHE Semester 2 C				BE 18MEL47A ME Semester 4 A		BE 17ME655 ME Semester 6 A
SAT				BE 17ME655 ME Semester 6 A		BE 18EME25 CHE Semester 2 C		

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3 . Department Details

5 . 1 Preliminary Information

PROGRAM EDUCATIONAL OBJECTIVES

Peo 1 : To produce engineers with in-depth knowledge of Basic engineering concepts in mathematics, physics, chemistry, mechanical, civil, electrical and electronics, computer science and biological sciences for engineering application

Peo 2 : To train the students with technical skills in biotechnology and interdisciplinary field to meet the industrial demands

Peo 3 : To upgrade the skills in microbial processes and computer based applications in Biotechnology

Peo 4 : To expertise the students with analytical and problem solving abilities with special emphasis on research, entrepreneurship and career

Peo 5 : To create responsible biotechnology engineers with high ethical and moral values

PROGRAM OUTCOMES(PO's)

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

2. **Problem Analysis :** Identify, formulate, review research literature, and analyze 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 the public health and safety, and the 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 the 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

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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 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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4 . Course Information

6 . 1 Course Content

Title of the Course : ELEMENTS OF MECHANICAL ENGINEERING
Semester : 2 **Academic Year : 2019-20**

Subject Code : 18EME25	IA Marks : 40
Hours/week : 5	Total Hours : 50
Exam Hours : 3	Exam Marks : 60
Course Plan Author : Nishchitha K M	Planned Date : 2020-02-10
Approved by : Dr Ranganatha Swamy. L	Approved Date : 2020-02-10

Objectives:

1 . Students belonging to different disciplines of Engineering are made to learn few fundamental topics related to Mechanical Engineering systems.

Course Outcomes (COs) :

1 . Develop the basic knowledge of Energy sources, Boilers, IC engines and Refrigeration & Air \nconditioning systems.

2 . Understand the various Machine tools, Metal joining processes, Power transmission systems and \nBearings & Lubrication systems.

3 . Understand the applications of various Engineering & Composite materials.

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6 . Course Information

6 . 1 . 1 Course Syllabus

Objectives:
Title of the Course : ELEMENTS OF MECHANICAL ENGINEERING
Subject Code : 18EME25

Module 1

Energy Sources & Boilers :

Energy Sources: Introduction, Types & Examples, Solar Power Plant, Hydroelectric Power Plant & Wind Power Plant.

Steam: Steam formation, Steam properties , Dryness fraction, Sensible heat, Latent heat, Total heat, Specific volume & Internal energy, Types of Steam (No numerical problems).

Boilers: Introduction, Classification, List & Functions of Boiler Mountings & Accessories (No constructional details), [Self Study: Babcock & Wilcox Boiler].

Turbines: Steam Turbines: Introduction, Working Principle of Impulse & Reaction Turbines.

Gas Turbines: Introduction, Working Principle of Open and Closed cycle Gas Turbines.

Hydraulic Turbines : Introduction, Working Principle of Pelton and Kaplan Turbines.

Module 2

Internal Combustion Engines:

Introduction, Classification, Parts, Terminology, P-V Diagrams of Otto and Diesel Cycles, Simple Numerical Problems on Indicated Power, Brake Power, Mechanical Efficiency, Indicated Thermal Efficiency and Brake Thermal Efficiency, [Self Study: Working of 2-Stroke & 4-Stroke IC Engines].

Refrigeration & Air conditioning:

Introduction, Definitions , Refrigerating Effect, Ton of Refrigeration, Unit of Refrigeration, Coefficient of\performance (COP), Refrigerants \u2013 Properties & Commonly Used, Principle and Working of Vapour\compression and Vapor Absorption Refrigerators, Introduction to Air conditioning, Working Principle of\domestic Air Conditioner.

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Module 3

Machine Tools: Turning Machine:

Parts, Classification and Operations performed (Turning, Taper turning, Facing, \knurling, Thread cutting).

Drilling Machine: Working Principle of Drilling, Classification and Operations performed (Boring, \reaming, Tapping, Counter Sinking & Counter Boring).

Grinding Machine: Working Principle of Grinding, Working Operation of Surface Grinding, and Cylindrical\grinding & Center less Grinding.

Metal Joining Processes: Welding: Definition, Classification, Advantages, Disadvantages, Applications, Brief Discussion on Electric\Arc Welding & Oxy, Acetylene Gas Welding, Types of Gas Flames.

Soldering: Definition, Applications, Working Principle, and Types of Solder.

Brazing: Definition, Applications, Working Principle, and Comparison of Welding, Soldering & Brazing.

Module 4

Power Transmission:Belt Drives : Types (Open & Crossed), Definitions , Velocity Ratio, Creep, Slip. Pulley Drives : Types (Idler, Stepped Cone and Fast & Loose). Gear Drives : Introduction, Types of Gear Train, [Simple Numerical Problems].

Bearings & Lubrication: Bearings : Introduction, Types \u2013

Ball & Roller Bearings. Lubrication : Definition, Purposes,

Types, Drop Feed & Splash, Types & Properties of Lubricants.

Module 5

Engineering Material: Introduction, Types and Applications of Ferrous & Non-Ferrous Metals and Alloys, Ceramics and Polymers.

Composite Materials: Introduction, Classification, Advantages, Limitations, Industrial Applications.

6 . Course Information

6 . 1 . 2 Text Books and Reference Books

TEXT BOOKS :

1 . K. R. Gopalakrishna, Sudhir Gopalakrishna, S. C. Sharma, "Text Book of Elements of Mechanical Engineering", Subhas Publications, 2015.

2 . S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, "Elements of Workshop Technology – Vol-1&2", Media Promoters & Publishers Pvt. Ltd., 2010.

REFERENCE BOOKS :

1 . S. Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", IK International Publishing Pvt. Ltd., 2010.

2 . Kestoor Praveen & Ramesh, "Elements of Mechanical Engineering", Suggi Publishing, 2015.

3 . K. V. A. Balaji & K. Ramashastry, "Elements of Mechanical Engineering Sciences", Sanguine Technical Publishers, 2006.

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6. Course Information

6.2

Semester: 2 **Section:** C **Course:** ELEMENTS OF MECHANICAL ENGINEERING

Period	Planned			Execution		
	Date	Topic	Source material to be referred	Date	Topic	Source material to be referred
			1			
1	2020-02-11	Energy Sources: Introduction	-	2020-02-11	Energy Sources: Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
2	2020-02-11	Energy Sources: Introduction	-	2020-02-11	Energy Sources: Introduction	Text 1, Ref 2,
3	2020-02-12	Types & Examples	-	2020-02-12	Types & Examples	Text 1, Ref 2,
4	2020-02-14	Solar Power Plant	-	2020-02-14	Solar Power Plant	Text 2, Text 1, Ref 1, Ref 2, Ref 3,
5	2020-02-15	Hydroelectric Power Plant & Wind\nPower Plant.	-	2020-02-15	Hydroelectric Power Plant & WindPower Plant.	Text 1, Ref 1,
6	2020-02-18	Steam formation, Steam properties , Dryness fraction, Sensible heat, Latent heat, Total heat, \nSpecific volume & Internal energy, Types of Steam (No numerical problems).	-	2020-02-18	Steam formation, Steam properties, Dryness fraction, Sensible heat, Latent heat, Total heat, Specific volume & Internal energy, Types of Steam (No numerical problems).	Ref 1, Ref 2, Text 1, Text 2, Ref 3,
7	2020-02-18	Introduction, Classification, List & Functions of Boiler Mountings & Accessories (No constructional details), [Self Study: Babcock & Wilcox Boiler].	-	2020-02-18	Introduction, Classification, List & Functions of Boiler Mountings & Accessories (No constructional details), [Self Study: Babcock & Wilcox Boiler].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
8	2020-02-19	Introduction, Working Principle of Impulse & Reaction Turbines.	-	2020-02-19	Introduction, Working Principle of Impulse & Reaction Turbines.	Text 1, Text 2, Ref 1, Ref 2

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9	2020-02-22	Introduction, Working Principle of Open and Closed cycle Gas Turbines.	-	2020-02-22	Introduction, Working Principle of Open and Closed cycle Gas Turbines.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
10	2020-02-25	Introduction, Working Principle of Pelton and Kaplan Turbines.	-	2020-02-25	Introduction, Working Principle of Pelton and Kaplan Turbines.	Ref 2, Text 1, Text 2, Ref 1, Ref 3,
			2			
11	2020-03-03	Introduction, Classification	-	2020-03-03	Introduction, Classification	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
12	2020-03-03	Parts, Terminology	-	2020-03-03	Parts, Terminology	Ref 2
13	2020-03-04	P-V Diagrams of Otto and Diesel Cycles, Simple \nNumerical Problems on Indicated Power	-	2020-03-04	P-V Diagrams of Otto and Diesel Cycles, SimpleNumerical Problems on Indicated Power	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
14	2020-03-06	Brake Power, Mechanical Efficiency	-	2020-03-06	Brake Power, Mechanical Efficiency	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
15	2020-03-07	Indicated Thermal Efficiency and Brake Thermal Efficiency, [Self Study: Working of 2-Stroke & 4-Stroke IC Engines].	-	2020-03-07	Indicated Thermal Efficiency and Brake Thermal Efficiency, [Self Study: Working of 2-Stroke & 4-Stroke IC Engines].	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
16	2020-03-10	Introduction, Definitions	-	2020-03-10	Introduction, Definitions	Ref 2
17	2020-03-10	Refrigerating Effect, Ton of Refrigeration	-	2020-03-10	Refrigerating Effect, Ton of Refrigeration	Ref 2, Text 1,
18	2020-03-11	Unit of Refrigeration, Coefficient of \nPerformance (COP)	-	2020-03-11	Unit of Refrigeration, Coefficient ofPerformance (COP)	Text 1
19	2020-03-13	Refrigerants \u2013 Properties & Commonly Used, Principle and Working of Vapour \nCompression and Vapour Absorption Refrigerators	-	2020-03-13	Refrigerants \u2013 Properties & Commonly Used, Principle and Working of VapourCompression and Vapour Absorption Refrigerators	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
20	2020-03-14	Introduction to Air conditioning, Working Principle of\nDomestic Air	-	2020-03-14	Introduction to Air conditioning, Working Principle ofDomestic Air	Text 2, Ref 2,

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3						
21	2020-03-17	Parts, Classification and Operations performed (Turning	-	2020-03-17	Parts, Classification and Operations performed (Turning	Text 2, Ref 2,
22	2020-03-17	Taper turning	-	2020-03-17	Taper turning	Text 1, Ref 2,
23	2020-03-18	Facing	-	2020-03-18	Facing	Ref 2
24	2020-03-24	\nKnurling	-	2020-03-24	Knurling	Ref 2, Text 2,
25	2020-03-24	Thread cutting).	-	2020-03-24	Thread cutting).	Ref 2, Text 2,
26	2020-03-27	Working Principle of Drilling, Classification and Operations performed (Boring,\nReaming, Tapping, Counter Sinking & Counter Boring).	-	2020-03-27	Working Principle of Drilling, Classification and Operations performed (Boring, Reaming, Tapping, Counter Sinking & Counter Boring).	Ref 2, Text 2,
27	2020-03-28	Working Principle of Grinding, Working Operation of Surface Grinding, Cylindrical \nGrinding & Centerless Grinding.	-	2020-03-28	Working Principle of Grinding, Working Operation of Surface Grinding, CylindricalGrinding & Centerless Grinding.	Text 1, Ref 2,
28	2020-03-31	Definition, Classification, Advantages, Disadvantages, Applications, Brief Discussion on Electric\nArc Welding & Oxy,Acetylene Gas Welding, Types of Gas Flames.	-	2020-03-31	Definition, Classification, Advantages, Disadvantages, Applications, Brief Discussion on ElectricArc Welding & Oxy, Acetylene Gas Welding, Types of Gas Flames.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
29	2020-03-31	Definition, Applications, Working Principle, Types of Solder.	-	2020-03-31	Definition, Applications, Working Principle, Types of Solder.	Text 2, Ref 2,
30	2020-03-31	Definition, Applications, Working Principle, Comparison of Welding, Soldering & Brazing.	-	2020-03-31	Definition, Applications, Working Principle, Comparison of Welding, Soldering & Brazing.	Text 1, Ref 2,
4						
31	2020-04-01	Types (Open & Crossed), Definitions , Velocity Ratio	-	2020-04-01	Types (Open & Crossed), Definitions, Velocity Ratio	Ref 2, Text 2,
32	2020-04-03	Creep, Slip.	-	2020-04-03	Creep, Slip.	Text 2
33	2020-04-04	Types (Idler	-	2020-04-04	Types (Idler	Text 2
34	2020-04-07	Stepped Cone and Fast & Loose).	-	2020-04-07	Stepped Cone and Fast & Loose).	Text 2, Ref 2, Text 1, Ref 1, Ref 3,

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36	2020-04-08	[Simple Numerical Problems].	-	2020-04-08	[Simple Numerical Problems].	Ref 2, Text 1, Text 2, Ref 1, Ref 3,
37	2020-04-11	Introduction	-	2020-04-11	Introduction	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
38	2020-04-15	Types \u2013 Ball & Roller Bearings.	-	2020-04-15	Types \u2013 Ball & Roller Bearings.	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
39	2020-04-17	Definition, Purposes, Types	-	2020-04-17	Definition, Purposes, Types	Ref 2, Text 1,
40	2020-04-18	Drop Feed & Splash,Types & Properties of Lubricants.	-	2020-04-18	Drop Feed & Splash, Types & Properties of Lubricants.	Ref 2
5						
41	2020-04-24	Introduction	-	2020-04-24	Introduction	Text 2
42	2020-04-25	Introduction	-	2020-04-25	Introduction	Ref 2
43	2020-04-28	Types and Applications of Ferrous & Non-Ferrous Metals and Alloys	-	2020-04-28	Types and Applications of Ferrous & Non-Ferrous Metals and Alloys	Text 1, Text 2, Ref 1, Ref 2, Ref 3,
44	2020-04-28	Types and Applications of Ferrous & Non-Ferrous Metals and Alloys	-	2020-04-28	Types and Applications of Ferrous & Non-Ferrous Metals and Alloys	Ref 2, Text 2,
45	2020-04-29	Ceramics and Polymers.	-	2020-04-29	Ceramics and Polymers.	Ref 2, Text 2,
46	2020-05-02	Introduction	-	2020-05-02	Introduction	Ref 2, Text 2,
47	2020-05-05	Classification	-	2020-05-05	Classification	Ref 2, Text 2,
48	2020-05-05	Advantages	-	2020-05-05	Advantages	Ref 2, Text 2,
49	2020-05-06	Limitations	-	2020-05-06	Limitations	Ref 2, Text 2,
50	2020-05-08	Industrial Applications.	-	2020-05-08	Industrial Applications.	Ref 2, Text 2,

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6 . Course Information

6 . 2 . 1 Compliance Report

Semester : 2 **Section :** C **Course :** ELEMENTS OF MECHANICAL ENGINEERING

Module No.	# of Classes Planned(till date)	Planned Effort(till date)	# of Classes Executed(till date)	Actual Efforts(till date)	% Coverage
1	10	9hrs 10min	10	9hrs 10min	100.0
2	10	9hrs 10min	10	9hrs 10min	100.0
3	10	9hrs 10min	10	9hrs 10min	100.0
4	10	9hrs 10min	10	9hrs 10min	100.0
5	10	9hrs 10min	10	9hrs 10min	100.0

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Adichunchanagiri Shikshana Trust (R)

BGS INSTITUTE OF TECHNOLOGY

Department of Mechanical Engineering

CO-PO & CO-PSO mapping (18 Scheme)

Programme	Course Code	Subject	Credits	L-T-P-TL	Assessment		Exam Duration
					SEE	CIA	
B.E	18ME15/ 25	Elements Of Mechanical Engineering	04	3-2-0-5	60	40	3Hrs

Co's

18C112.1	Develop the basic knowledge of Energy sources, Boilers, IC engines and Refrigeration & Air conditioning systems.
18C112.2	Understand the various Machine tools, Metal joining processes, Power transmission systems and Bearings & Lubrication systems.
18C112.3	Understand the applications of various Engineering & Composite materials.

Po & Pso's

PSO-1: Ability to acquire competencies in designing, analyzing and evaluating the mechanical components.

PSO-2: Ability to work professionally by applying manufacturing and management practices.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C112.1	2	2	1	-	-	1	1	-	-	-	-	1	1	1
C112.2	2	2	-	-	-	1	1	-	-	-	-	1	1	1
C112.3	2	-	-	-	-	-	1	-	-	-	-	1	1	1
/G	2	2	1	-	-	1	1	-	-	-	-	1	1	1

Course Owner

HOD
Dept. of Pre Engineering
BGS Institute of Technology
B G Nagara- 571448
Nagamangala Taluk, Mandya District.

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Elements of Mechanical Engg

|| Jai Sri Gurudev ||

BGS Institute of Technology

BG Nagara – 571448, Mandya District

Department of Mechanical Engineering

II Semester

Assignment 1

Date of submission: 23.05.2020

1. With suitable sketch explain all lathe operation?
2. With suitable sketch explain all drilling operation?
3. Explain soldering. What fluxes are commonly used in soldering? Why is flux necessary?
4. Compare soldering and brazing process and welding process.
5. With a neat sketch explain working and construction of electric arc welding process.
6. With a neat sketch explain working and construction of oxy-acetylene welding process.
7. With a neat sketch explain, the three types of oxy-acetylene flames. Specify their application.
8. Explain the classification of engineering materials, explain
9. Explain the types of ferrous metals with their composition.
10. Explain the types of Non-ferrous metals with their composition.
11. Define composite material. List the advantages and dis advantages of composite materials.
12. Classify composites based on the types of matrix and reinforcements. List a few applications of composites in the field of composites in the field of air craft and automobiles.
13. Write a short note on particulate and laminated composites.
14. Discuss the properties and applications of (a) MMC (b) PMC (c) FRC

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BGS Institute of Technology

Department of Chemistry (CHE)

6 . Course Information

6 . 3 Other Assessment

ASSIGNMENT : 1

Semester:2-CBCS 2018

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18EME25)

Faculty : Nishchitha K M

Max Marks: 10

Answer All Questions

Q.No				Max Marks	CO	BT/CL
1			1	1	L2	
2			1	1	L2	
3			1	1	L2	
4			1	1	L2	
5			1	1	L2	
6			1	1	L2	
7			1	1	L2	
8			1	1	L2	
9			1	1	L2	
10			1	1	L2	

Evaluation

USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
19CVE001	Aishwarya T	P	10	Understand
19CVE002	Ajay H J	P	10	Understand
19CVE003	Arunkumar B R	P	10	Understand
19CVE004	Chandan A N	P	10	Understand
19CVE005	Chandana T R	P	10	Understand
19CVE006	Darshan Gowda R	P	10	Understand

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USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
19CVE008	Dhanush P K	P	10	Understand
19CVE009	Durgesh Mastappa Naik	P	10	Understand
19CVE010	Farhan Ahmed	P	10	Understand
19CVE011	Goutham D G	P	10	Understand
19CVE012	Harshith M Gowda	P	10	Understand
19CVE013	K R Mahendra	P	10	Understand
19CVE015	Kavana B P	P	10	Understand
19CVE016	Kishor R	P	10	Understand
19CVE017	Kushal Aradya D S	P	10	Understand
19CVE018	Likith Kumar M V	P	10	Understand
19CVE019	Manjunath G K	P	10	Understand
19CVE020	Manoj G N	P	10	Understand
19CVE021	Manoj K	P	10	Understand
19CVE022	Mohammed Umraz	P	10	Understand
19CVE023	Monisha H	P	10	Understand
19CVE024	Navya D	P	10	Understand
19CVE025	Nithin P	P	10	Understand
19CVE026	Pavan R J	P	10	Understand
19CVE027	Pavangowda T G	P	10	Understand
19CVE029	Pooja C	P	10	Understand
19CVE030	Praveen Kumar S B	P	10	Understand
19CVE031	Preetham K P	P	10	Understand
19CVE032	Purushotham	P	10	Understand
19CVE033	Sahana A	P	10	Understand
19CVE034	Sahana Y V	P	10	Understand
19CVE035	Saif Saqlain	P	10	Understand
19CVE036	Shridhara J K	P	10	Understand

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BGS Institute of Technology

Department of Chemistry (CHE)

USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
19CVE038	Sinchana K	P	10	Understand
19CVE039	Suhas G P	P	10	Understand
19CVE040	Suman C	P	10	Understand
19CVE041	Tarun M S	P	10	Understand
19CVE042	Ummer M	P	10	Understand
19CVE043	Varun N Gowda	P	10	Understand
19CVE044	Vishwakumar A R	P	10	Understand
19CVE045	Yashwanth H B	P	10	Understand
19CVE046	Yuvaraju U C	P	10	Understand
19CVE047	Zoya Mulk	P	10	Understand

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BGS Institute of Technology
Department of Chemistry (CHE)

ASSIGNMENT : 2

Semester:2-CBCS 2018

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18EME25)

Max Marks: 10

Faculty : Nishchitha K M

Answer All Questions					
Q.No			Max Marks	CO	BT/ CL
1			1	1	L2
2			1	1	L2
3			1	3	L2
4			1	23	L2
5			1	3	L2
6			1	3	L2
7			1	3	L2
8			1	3	L2
9			1	3	L2
10			1	2	L2

Evaluation

USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
19CVE001	Aishwarya T	P	10	Understand
19CVE002	Ajay H J	P	10	Understand
19CVE003	Arunkumar B R	P	10	Understand
19CVE004	Chandan A N	P	10	Understand
19CVE005	Chandana T R	P	10	Understand
19CVE006	Darshan Gowda R	P	10	Understand
19CVE007	Darshan M L	P	10	Understand
19CVE008	Dhanush P K	P	10	Understand

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ADICHUNCHANAGIRI UNIVERSITY

BGS Institute of Technology

BG Nagara – 571448, Mandya District

Department of Mechanical Engineering

2nd Semester

Assignment 1

1. What are heat engine how they are classified.
2. How are IC engine classified.
3. With the help of schematic diagram explain the working of single cylinder 4-stroke petrol engine; show all the process in a cycle on PV diagram.
4. With the help of schematic diagram explain the working of single cylinder 2-stroke Diesel engine;
5. Differentiate clearly between SI and CI Engine; give an example in each case.
6. Define the following 1. Break Power
   2. Indicated power
   3. Friction Power
   4. Mechanical Efficiency
   5. Thermal Efficiency
   6. Specific Fuel Consumption
7. What is the principle of refrigeration? Name the essential parts of refrigerator and briefly, explain their functions.
8. Write the desirable properties of a good refrigerant.
9. List the five commonly used refrigerants with their boiling points.
10. With a schematic diagram explain the working of Vapour Compression Refrigerator
11. With a schematic diagram explain the working of Vapour Absorption Refrigerator
12. What is air conditioning? With a suitable diagram show the flow path of refrigerant used in any air conditioner

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BGS Institute of Technology

Department of Chemistry (CHE)

USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
19CVE009	Durgesh Mastappa Naik	P	10	Understand
19CVE010	Farhan Ahmed	P	10	Understand
19CVE011	Goutham D G	P	10	Understand
19CVE012	Harshith M Gowda	P	10	Understand
19CVE013	K R Mahendra	P	10	Understand
19CVE015	Kavana B P	P	10	Understand
19CVE016	Kishor R	P	10	Understand
19CVE017	Kushal Aradya D S	P	10	Understand
19CVE018	Likith Kumar M V	P	10	Understand
19CVE019	Manjunath G K	P	10	Understand
19CVE020	Manoj G N	P	10	Understand
19CVE021	Manoj K	P	10	Understand
19CVE022	Mohammed Umraz	P	10	Understand
19CVE023	Monisha H	P	10	Understand
19CVE024	Navya D	P	10	Understand
19CVE025	Nithin P	P	10	Understand
19CVE026	Pavan R J	P	10	Understand
19CVE027	Pavangowda T G	P	10	Understand
19CVE029	Pooja C	P	10	Understand
19CVE030	Praveen Kumar S B	P	10	Understand
19CVE031	Preetham K P	P	10	Understand
19CVE032	Purushotham	P	10	Understand
19CVE033	Sahana A	P	10	Understand
19CVE034	Sahana Y V	P	10	Understand
19CVE035	Saif Saqlain	P	10	Understand
19CVE036	Shridhara J K	P	10	Understand
19CVE037	Sinchana C R	P	10	Understand

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BGS Institute of Technology

Department of Chemistry (CHE)

USN	Name	Present (P) / Absent (Ab)	IA Total	Blooms Level
19CVE039	Suhas G P	P	10	Understand
19CVE040	Suman C	P	10	Understand
19CVE041	Tarun M S	P	10	Understand
19CVE042	Ummer M	P	10	Understand
19CVE043	Varun N Gowda	P	10	Understand
19CVE044	Vishwakumar A R	P	10	Understand
19CVE045	Yashwanth H B	P	10	Understand
19CVE046	Yuvaraju U C	P	10	Understand
19CVE047	Zoya Mulk	P	10	Understand

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USN :

BGS Institute of Technology, Mandya

DEPARTMENT OF CHEMISTRY

I - INTERNAL ASSESSMENT

Semester: 2-CBCS 2018
Subject: ELEMENTS OF MECHANICAL ENGINEERING (18EME25)
Faculty:

Date: 8 May 2020
Time: 04:00 PM - 05:00 PM
Max Marks: 30

Instructions to Students :

i)Select one question from each part.
ii) All questions carry equal marks.

PART A

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
1	a	with a neat sketch explain a) solar flat plate collector b)solar pond	8	CO1	L2
	b	Compare renewable and non renewable energy resources	7	CO1	L2
2	a	With a neat sketch explain the construction and working of impulse turbine (de laval turbine) with the help of pressure-velocity diagram?	7	CO1	L2
	b	With a neat sketch explain the construction and working of Kaplan turbine.	8	CO1	L2

PART B

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
3	a	Compare 2 stroke and 4 stroke engine?	6	CO1	L2
	b	With the help of PV diagram, describe the working of a 4 stroke petrol engine.	9	CO1	L2
4	a	With suitable sketch explain the working of vapor absorption refrigeration system.	7	CO1	L2
	b	With suitable sketch explain the working of room air conditioning system	8	CO1	L2

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution – TEST – I

Date: 08-05-2020

Semester: II Subject Title: Elements of Mechanical Engg. Subject Code: 18ME25

Question Number	Solution	Marks Allocated
1 a)	Solar flat plate collector. Sketch : 2m Explatn : 2m.	8m.
b)	Comparision. Renewable Non-Renewable. ① ② ③ ④ ⑤ ⑥ ⑦.	7m.
2. a)	Impulse-turbine. Sketch : 2 m Construction : 2 m Working : 2 m PV diagram : 1 m	7m ~~8m~~.
b)	kaplan turbine. Sketch. : 3 construction : 3 working : 2.	8m.

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Question Number	Solution	Marks Allocated
	Part . B.	
3.		
a)	2 stroke / 4 stroke. → ① → ② → ③ → ④ → ⑤ → ⑥.	6m.
b)	PV diagram. 1m working 4 stroke Engine. 8m	9m.
4)	Vapour absorption Refrigeration System.	
a)	Sketch. 3m working 4m	7m
b)	Room-Air Conditioning System. Sketch. 4m. Working 4m	8m.

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6 . Course Information

6 . 4 Internal Assessment

Internal : 1

Semester:2-CBCS 2018

Date : 08/05/2020

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18EME25)

Time : 16:00 - 17:00

Faculty : Nishchitha K M

Max Marks: 30

Q.No			Max Marks	CO	BT/CL
Part A					
Answer any 1 questions					
1	a	*with a neat sketch explain a) solar flat plate collector b)solar pond*	8	1	L2
1	b	*Compare renewable and non renewable energy resources*	7	1	L2
2	a	*With a neat sketch explain the construction and working of impulse turbine (de laval turbine) with the help of pressure-velocity diagram?*	7	1	L2
2	b	*With a neat sketch explain the construction and working of Kaplan turbine.*	8	1	L2

Q.No		Max Marks	CO	BT/CL
Part B				
Answer any 1 questions				

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3	a	Compare 2 stroke and 4 stroke engine?	6	1	L2
3	b	With the help of PV diagram, describe the working of a 4 stroke petrol engine.	9	1	L2
4	a	With suitable sketch explain the working of vapor absorption refrigeration system.	7	1	L2
4	b	With suitable sketch explain the working of room air conditioning system	8	1	L2

Evaluation

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
19CVE001	Aishwarya T	P	8	7	0	0	6	9	0	0	30	Understand
19CVE002	Ajay H J	Ab	0	0	0	0	0	0	0	0	0	No Level
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
19CVE005	Chandana T R	P	6	5	0	0	6	4	0	0	21	Understand
19CVE006	Darshan Gowda R	P	8	7	0	0	0	0	7	3	25	Understand
19CVE007	Darshan M L	P	6	6	0	0	5	5	0	0	22	Understand
19CVE008	Dhanush P K	P	0	0	6	6	0	0	6	7	25	Understand
19CVE009	Durgesh Mastappa Naik	P	0	0	7	8	6	9	0	0	30	Understand
19CVE010	Farhan Ahmed	P	6	5	0	0	5	5	0	0	21	Understand
19CVE011	Goutham D G	P	7	6	0	0	0	0	5	4	22	Understand
19CVE012	Harshith M Gowda	P	6	6	0	0	6	9	0	0	27	Understand
19CVE013	K R Mahendra	P	6	6	0	0	6	5	0	0	23	Understand
19CVE015	Kavana B P	P	8	7	0	0	6	8	0	0	29	Understand
19CVE016	Kishor R	P	0	0	0	0	0	0	0	0	0	No Level
19CVE017	Kushal Aradya D S	P	8	7	0	0	0	0	0	0	15	Understand
19CVE018	Likith Kumar M V	P	0	0	7	6	6	8	0	0	27	Understand
19CVE019	Manjunath G K	P	8	6	0	0	0	0	7	7	28	Understand
19CVE020	Manoj G N	P	6	4	0	0	0	0	4	4	18	Understand
19CVE021	Manoj K	P	6	7	0	0	5	6	0	0	24	Understand
19CVE022	Mohammed Umraz	P	8	7	0	0	0	0	7	7	29	Understand
19CVE023	Monisha H	P	8	7	0	0	6	8	0	0	29	Understand
19CVE024	Navya D	P	5	5	0	0	5	5	0	0	20	Understand
19CVE025	Nithin P	P	8	7	0	0	0	0	7	7	29	Understand
19CVE026	Pavan R J	P	0	0	7	8	6	8	0	0	29	Understand
19CVE027	Pavangowda T G	Ab	0	0	0	0	0	0	0	0	0	No Level
19CVE029	Pooja C	P	8	6	0	0	6	8	0	0	28	Understand
19CVE030	Praveen Kumar S B	P	0	0	0	0	6	9	0	0	15	Understand
19CVE031	Preetham K P	P	7	7	0	0	0	0	7	7	28	Understand
19CVE032	Purushotham	P	6	6	0	0	0	0	7	8	27	Understand
19CVE033	Sahana A	P	0	0	7	7	6	8	0	0	28	Understand
19CVE034	Sahana Y V	P	8	7	0	0	6	8	0	0	29	Understand
19CVE035	Saif Saqlain	P	8	7	0	0	0	0	0	0	15	Understand
19CVE036	Shridhara J K	P	0	0	7	5	6	5	0	0	23	Understand
19CVE037	Sinchana C R	P	8	7	0	0	0	0	6	8	29	Understand
19CVE038	Sinchana K	P	7	7	0	0	0	0	7	7	28	Understand
19CVE039	Suhas G P	P	0	0	0	0	6	9	0	0	15	Understand
19CVE040	Suman C	P	7	7	0	0	6	6	0	0	26	Understand
19CVE041	Tarun M S	P	0	0	7	8	6	8	0	0	29	Understand

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BGS Institute of Technology

Department of Chemistry (CHE)

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
19CVE005	Chandana T R	P	6	5	0	0	6	4	0	0	21	Understand
19CVE006	Darshan Gowda R	P	8	7	0	0	0	0	7	3	25	Understand
19CVE007	Darshan M L	P	6	6	0	0	5	5	0	0	22	Understand
19CVE008	Dhanush P K	P	0	0	6	6	0	0	6	7	25	Understand
19CVE009	Durgesh Mastappa Naik	P	0	0	7	8	6	9	0	0	30	Understand
19CVE010	Farhan Ahmed	P	6	5	0	0	5	5	0	0	21	Understand
19CVE011	Goutham D G	P	7	6	0	0	0	0	5	4	22	Understand
19CVE012	Harshith M Gowda	P	6	6	0	0	6	9	0	0	27	Understand
19CVE013	K R Mahendra	P	6	6	0	0	6	5	0	0	23	Understand
19CVE015	Kavana B P	P	8	7	0	0	6	8	0	0	29	Understand
19CVE016	Kishor R	P	0	0	0	0	0	0	0	0	0	No Level
19CVE017	Kushal Aradya D S	P	8	7	0	0	0	0	0	0	15	Understand
19CVE018	Likith Kumar M V	P	0	0	7	6	6	8	0	0	27	Understand
19CVE019	Manjunath G K	P	8	6	0	0	0	0	7	7	28	Understand
19CVE020	Manoj G N	P	6	4	0	0	0	0	4	4	18	Understand
19CVE021	Manoj K	P	6	7	0	0	5	6	0	0	24	Understand
19CVE022	Mohammed Umraz	P	8	7	0	0	0	0	7	7	29	Understand
19CVE023	Monisha H	P	8	7	0	0	6	8	0	0	29	Understand
19CVE024	Navya D	P	5	5	0	0	5	5	0	0	20	Understand
19CVE025	Nithin P	P	8	7	0	0	0	0	7	7	29	Understand
19CVE026	Pavan R J	P	0	0	7	8	6	8	0	0	29	Understand
19CVE027	Pavangowda T G	Ab	0	0	0	0	0	0	0	0	0	No Level
19CVE029	Pooja C	P	8	6	0	0	6	8	0	0	28	Understand
19CVE030	Praveen Kumar S B	P	0	0	0	0	6	9	0	0	15	Understand
19CVE031	Preetham K P	P	7	7	0	0	0	0	7	7	28	Understand
19CVE032	Purushotham	P	6	6	0	0	0	0	7	8	27	Understand
19CVE033	Sahana A	P	0	0	7	7	6	8	0	0	28	Understand
19CVE034	Sahana Y V	P	8	7	0	0	6	8	0	0	29	Understand
19CVE035	Saif Saqlain	P	8	7	0	0	0	0	0	0	15	Understand
19CVE036	Shridhara J K	P	0	0	7	5	6	5	0	0	23	Understand
19CVE037	Sinchana C R	P	8	7	0	0	0	0	6	8	29	Understand
19CVE038	Sinchana K	P	7	7	0	0	0	0	7	7	28	Understand
19CVE039	Suhas G P	P	0	0	0	0	6	9	0	0	15	Understand
19CVE040	Suman C	P	7	7	0	0	6	6	0	0	26	Understand
19CVE041	Tarun M S	P	0	0	7	8	6	8	0	0	29	Understand

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BGS Institute of Technology

Department of Chemistry (CHE)

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3		Q4		IA Total	BT/CL
			a	b	a	b	a	b	a	b		
19CVE043	Varun N Gowda	Ab	0	0	0	0	0	0	0	0	0	No Level
19CVE044	Vishwakumar A R	P	6	7	0	0	6	4	0	0	23	Understand
19CVE045	Yashwanth H B	P	8	7	0	0	0	0	0	0	15	Understand
19CVE046	Yuvaraju U C	P	6	7	0	0	6	8	0	0	27	Understand
19CVE047	Zoya Mulk	P	8	6	0	0	6	8	0	0	28	Understand

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USN :

BGS Institute of Technology, Mandya
DEPARTMENT OF CHEMISTRY
II - INTERNAL ASSESSMENT

Semester: 2-CBCS 2018
Subject: ELEMENTS OF MECHANICAL ENGINEERING (18EME25)
Faculty: Ms Nishchitha K M

Date: 12 Jun 2020
Time: 02:00 PM - 03:00 PM
Max Marks: 30

Instructions to Students :

1.Select one question from each part
2. All questions carry equal marks.

PART A

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
1	a	With a neat sketch explain any four machine tool operation on lathe.	8	CO3	L2
	b	With a neat sketch explain any three drilling operations	7	CO3	L2
2	a	compare soldering and brazing process	7	CO3	L2
	b	With a neat sketch explain the working principle of oxy-acetylene welding process.	8	CO3	L2

PART B

Answer any1 question(s)

Q.No			Marks	CO	BT/CL
3	a	explain the types of flames in oxy-acetylene welding process	6	CO3	L2
	b	What are the engineering materials? Classify them suitably.	5	CO3	L2
	c	write a short note on , i)cast iron ii) wrought iron.	4	CO3	L2
4	a	write a short note on, i)copper ii)aluminum	4	CO3	L2
	b	Discuss the properties and application of a) MMC b)PMC c) FRC	6	CO3	L2
	c	Classify and explain in brief the various composite materials.	5	CO3	L2

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CBCS Scheme (VTU)

DEPARTMENT: MECHANICAL ENGINEERING

Scheme & Solution – TEST – 3 Date: 13.07.2020

Semester: II Subject Title: Elements of Mechanical Engg Subject Code: 18EME25

Question Number	Solution	Marks Allocated
1.	PART – A	
a)	Turning diagram Explanⁿ 2m Facing diagram Explanation 2m Knurling diagram. Explanation 2m Taper-turning. diagram Explanation. 2m	8m
b)	Drilling operation. Boring – Sketch, explanation Taping – Sketch, Explanation Reaming – Sketch, Explanation Counter sinking – Sketch, Explanation.	7m

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Question Number	Solution	Marks Allocated
2) a)	Comparision Soldering Brazing → ① → ② → ③ → ④ → ⑤ → ⑥ → ⑦.	7m.
b)	Oxy-Acetylene Welding Process. Sketch - 4m Explanation - 4m	8m
	Part B	
3. a)	Flames. → ① Carburizing - 2m → ② Oxidising - 2m → ③ Neutral - 2m	6m
b)	~~Engg Material~~ Classification.	5m
c)	Cast iron → ① → ② 2m Wrought Iron → ① → ② 2m	4m

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Question Number	Solution	Marks Allocated
4. a)	Copper → ① → ② 2m Aluminium — ① — ② 2m	4m
b)	MMC ① ② 2m PMC ① ② 2m FRC ① ② 2m	6m
c)	Classification of Composite materials	5m

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BGS Institute of Technology

Department of Chemistry (CHE)

Internal : 2

Semester:2-CBCS 2018 — Date : 12/06/2020

Subject : ELEMENTS OF MECHANICAL ENGINEERING (18EME25) — Time : 14:00 - 15:00

Faculty : Nishchitha K M — Max Marks: 30

Part A

Answer any 1 questions

Q.No			Max Marks	CO	BT/CL
1	a	With a neat sketch explain any four machine tool operation on lathe.	8	3	L2
1	b	With a neat sketch explain any three drilling operations	7	3	L2
2	a	compare soldering and brazing process	7	3	L2
2	b	With a neat sketch explain the working principle of oxy-acetylene welding process.	8	3	L2

Part B

Answer any 1 questions

Q.No			Max Marks	CO	BT/CL
3	a	explain the types of flames in oxy-acetylene welding process	6	3	L2

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3	b	*What are the engineering materials? Classify them suitably.*	5	3	L2
3	c	*write a short note on , i)cast iron ii) wrought iron.*	4	3	L2
4	a	*write a short note on, i)copper ii)aluminum*	4	3	L2
4	b	*Discuss the properties and application of a) MMC b)PMC c) FRC*	6	3	L2
4	c	*Classify and explain in brief the various composite materials.*	5	3	L2

Evaluation

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3			Q4			IA Total	BT/CL
			a	b	a	b	a	b	c	a	b	c		
19CVE001	Aishwarya T	P	0	0	7	8	0	0	0	4	5	5	29	Understand
19CVE002	Ajay H J	P	6	4	0	0	4	4	2	0	0	0	20	Understand
19CVE003	Arunkumar B R	P	0	0	6	6	5	5	4	0	0	0	26	Understand
19CVE004	Chandan A N	P	8	7	0	0	0	0	0	0	6	0	21	Understand
19CVE005	Chandana T R	P	8	6	0	0	4	5	0	0	0	0	23	Understand
19CVE006	Darshan Gowda R	P	8	0	0	0	5	5	4	0	0	0	22	Understand
19CVE007	Darshan M L	P	0	0	7	7	5	5	4	0	0	0	28	Understand
19CVE008	Dhanush P K	P	0	0	6	7	4	4	4	0	0	0	25	Understand

p

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BGS Institute of Technology

Department of Chemistry (CHE)

USN	Name	Present (P) / Absent (Ab)	Q1		Q2		Q3			Q4			IA Total	BT/CL
			a	b	a	b	a	b	c	a	b	c		
19CVE009	Durgesh Mastappa Naik	P	8	7	0	0	6	5	4	0	0	0	30	Understand
19CVE010	Farhan Ahmed	P	7	5	0	0	0	0	0	4	5	5	26	Understand
19CVE011	Goutham D G	P	7	6	0	0	4	4	4	0	0	0	25	Understand
19CVE012	Harshith M Gowda	P	0	0	6	7	0	0	0	4	5	5	27	Understand
19CVE013	K R Mahendra	P	0	0	7	7	0	0	0	0	6	5	25	Understand
19CVE015	Kavana B P	P	0	0	6	7	0	0	0	4	6	5	28	Understand
19CVE016	Kishor R	P	7	7	0	0	5	5	0	0	0	0	24	Understand
19CVE017	Kushal Aradya D S	P	0	0	6	5	4	4	4	0	0	0	23	Understand
19CVE018	Likith Kumar M V	P	0	0	6	7	5	5	4	0	0	0	27	Understand
19CVE019	Manjunath G K	P	7	7	0	0	5	5	4	0	0	0	28	Understand
19CVE020	Manoj G N	P	5	5	0	0	5	4	4	0	0	0	23	Understand
19CVE021	Manoj K	P	8	7	0	0	6	0	0	0	0	0	21	Understand
19CVE022	Mohammed Umraz	P	0	0	6	6	6	5	4	0	0	0	27	Understand
19CVE023	Monisha H	P	8	7	0	0	0	0	0	4	6	5	30	Understand
19CVE024	Navya D	P	8	7	0	0	5	5	4	0	0	0	29	Understand
19CVE025	Nithin P	P	0	0	7	7	5	5	4	0	0	0	28	Understand
19CVE026	Pavan R J	P	6	7	0	0	5	5	4	0	0	0	27	Understand
19CVE027	Pavangowda T G	P	7	7	0	0	0	0	0	0	0	0	14	Understand
19CVE029	Pooja C	P	0	0	7	7	6	5	4	0	0	0	29	Understand
19CVE030	Praveen Kumar S B	P	8	7	0	0	6	5	3	0	0	0	29	Understand
19CVE031	Preetham K P	P	0	0	6	7	6	0	4	0	0	0	23	Understand
19CVE032	Purushotham	P	0	0	6	8	0	0	0	4	5	0	23	Understand
19CVE033	Sahana A	P	8	7	0	0	0	0	0	4	5	5	29	Understand
19CVE034	Sahana Y V	P	0	0	6	7	5	4	3	0	0	0	25	Understand
19CVE035	Saif Saqlain	P	8	7	6	0	0	0	0	4	6	5	30	Understand
19CVE036	Shridhara J K	P	7	7	0	0	5	5	0	0	0	0	24	Understand
19CVE037	Sinchana C R	P	7	7	0	0	5	5	4	0	0	0	28	Understand
19CVE038	Sinchana K	P	0	0	6	7	6	5	4	0	0	0	28	Understand
19CVE039	Suhas G P	P	0	0	6	7	5	5	4	0	0	0	27	Understand
19CVE040	Suman C	P	0	0	6	6	0	0	0	4	5	5	26	Understand
19CVE041	Tarun M S	P	7	7	0	0	6	4	3	0	0	0	27	Understand
19CVE042	Ummer M	P	0	0	7	8	6	5	3	0	0	0	29	Understand
19CVE043	Varun N Gowda	P	8	7	0	0	5	5	4	0	0	0	29	Understand
19CVE044	Vishwakumar A R	P	0	0	6	7	6	5	4	0	0	0	28	Understand
19CVE045	Yashwanth H B	P	7	6	0	0	0	0	0	4	5	0	22	Understand
19CVE046	Yuvaraju U C	P	0	0	7	7	6	5	4	0	0	0	29	Understand

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MODULE – 1

ENERGY RESOURCES

Energy Resources: energy is defined as the capacity to do work. It is primary requirement for day to day activities of human beings.

ENERGY- Capacity to do work.

- Most of the energy that we use is mainly derived from conventional energy sources.

- Due to the vast demand of energy, the rate of depletion of these resources has reached alarmingly low levels.

- This situation has directed us to seek alternate energy sources such as solar, wind, ocean, biomass, Hydal etc.

ENERGY SOURCES:

- ➢ The energy existing in the earth is known as CAPITAL energy.
- ➢ Energy that comes from outer space is called CELESTIAL or INCOME energy.
- ➢ The CAPITAL energy sources are mainly, fossil fuels, nuclear fuels and heat traps.
- ➢ CELESTIAL ENERGY SOURCES ARE- Electromagnetic, gravitational and particle energy from stars, planets, moon etc.
- ➢ ELECTROMAGNETIC ENERGY of the earth's sun is called DIRECT SOLAR ENERGY. This results in WIND, HYDEL, GEOTHERMAL, BIOFUEL, etc.
- ➢ GRAVITATIONAL ENERGY of earth's moon produces TIDALENERGY.

RENEWABLE SOURCES OF ENERGY:

Energy sources which are continuously produced in nature and are essentially inexhaustible are called renewable energy sources.

1. Direct solar energy	2. Wind energy
3. Tidal energy	4. Hydel energy
5. Ocean thermal energy	6. Bio energy
7. Geo thermal energy	8. Peat
9. Fuel wood	10. Fuel cells
11. Solid wastes	12. Hydrogen

NONRENEWABLE ENERGY SOURCES:

Energy sources which have been accumulated over the ages and not quickly replenishable when they are exhausted.

1. Fossil fuels.
2. Nuclear fuels.
3. Heat traps.

ADVANTAGES OF RENEWABLE ENERGY SOURCES:

1. Non exhaustible.
2. Can be matched in scale to the need and can deliver quality energy.
3. Can be built near the load point.
4. Flexibility in the design of conversion systems.
5. Local self-sufficiency by harnessing locally available renewable energy.
6. Except biomass, all other sources are pollution free.

DISADVANTAGES OF RENEWABLE ENERGY SOURCES:

1. Intermittent nature of availability of energy such as solar, wind, tidal etc. is a major setback in the continuous supply of energy.
2. Solar energy received at the earth is dependent on local atmosphere conditions, time of the day,

part of the year etc.

3. Sources such as wind, tidal etc. are concentrated only in certain regions.
4. Technology is not fully developed to meet the present energy requirements.
5. Systems such as solar cells require advanced technologies and hence costlier.
6. Application to transport sector has been found to be not viable as on today.

ADVANTAGES OF NON-RENEWABLE ENERGY SOURCES:

1. Initial cost is lower. Hence widely used.
2. Unit power costs are much lower and so are economical

3. Sources are highly reliable.

4. Power generation technologies are well established.

DISADVANTAGES OF NON-RENEWABLE ENERGY SOURCES:

1. The sources are getting depleted and soon will be exhausted.

2. They pollute the atmosphere.

3. They are not freely available.

Petroleum based Fuels:

Formed mainly from ancient microscopic plants and bacteria that lived in the ocean and salt water seas. These micro-organisms died and settled to the sea floor, they mixed with sand silt to form organic rich mud which was gradually heated and compressed chemically transforming into petroleum. The liquid petroleum gases which are less dense than water move upwards through earth's crust. It passes through an impermeable layer of rock which traps the petroleum creating a reservoir of petroleum and natural gas.

Types of Fuels: - The important fuels are as follows-

1) Solid fuels, 2) Liquid fuels & 3) Gaseous fuels

Solid fuels

- ✓ Coal is the major fuel used for thermal power plants to generate steam.
- ✓ Coal occurs in nature, which was formed by the decay of vegetable matters buried under the earth millions of years ago under pressure and heat.
- ✓ This phenomenon of transformation of vegetable matter into coal under earth's crust is known as Metamorphism.
- ✓ The type of coal available under the earth's surface depends upon the period of metamorphism and the type of vegetable matter buried, also the pressure and temperature conditions.
- ✓ The major constituents in coal moisture (5-40%), volatile matter (combustible & or

incombustible substances about 50%) and ash (20-50%).

- ✓ The chemical substances in the coal are carbon, hydrogen, nitrogen, oxygen and sulphur.
- ✓ In the metamorphism phenomenon, the vegetable matters undergo the transformation from peat to anthracite coal, with intermediate forms of lignite and bituminous coal.

Liquid Fuels

- All types of liquid fuels used are derived from crude petroleum and its by-products.
- The petroleum or crude oil consists of 80-85% C, 10-15% hydrogen, and varying percentages of sulphur, nitrogen, oxygen and compounds of vanadium.
- The crude oil is refined by fractional distillation process to obtain fuel oils, for industrial as well as for domestic purposes.
- The fractions from light oil to heavy oil are naphtha, gasoline, kerosene, diesel and finally heavy fuel oil.
- The heavy fuel oil is used for generation of steam. The use of liquid fuels in thermal power plants has many advantages over the use of solid fuels.

Some important advantages are as follows:

1) The storage and handling of liquid fuels is much easier than solid and gaseous fuels.
2) Excess air required for the complete combustion of liquid fuels is less, as compared to the solid fuels.
3) Fire control is easy and hence changes in load can be met easily and quickly.
4) There are no requirements of ash handling and disposal.
5) The system is very clean, and hence the labour required is relatively less compared to the operation with solid fuels.

Gaseous Fuels

• For the generation of steam in gas fired thermal plants, either natural gas or manufactured gaseous fuels are used. However, manufactured gases are costlier than the natural gas.

• Generally, natural gas is used for power plants as it is available in abundance. The natural gas is generally obtained from gas wells and petroleum wells.

• The major constituent in natural gas is methane, about 60-65%, and also contains small amounts of other hydrocarbons such as ethane, naphthenic and aromatics, carbon dioxide and nitrogen.

• The natural gas is transported from the source to the place of use through pipes, for distances to several hundred kilometres.

• The natural gas is colourless, odourless and non-toxic.

• Its calorific value ranges from 25,000 to 50,000 kJ/m3, in accordance with the percentage of methane in the gas.

• The artificial gases are producer gas, water gas coke-oven gas; and the Blast furnace gas.

• Generally, power plants fired with artificial gases are not found.

• The gaseous fuels have advantages similar to those of liquid fuels, except for the storage problems.

• The major disadvantage of power plant using natural gas is that it should be setup near the source; otherwise the transportation losses are too high.

SOLAR POWER PLANT

Solar radiation is radiant energy emitted by the sun from a nuclear fusion reaction that creates electromagnetic energy. The spectrum of solar radiation is close to that of a black body with a temperature of about 5800 K. About half of the radiation is in the visible short- wave part of the electromagnetic spectrum.

Solar Constant Isc:

This is the amount of energy received in unit time on a unit perpendicular to the suns direction at the mean distance of the earth from the sun. The surface of the earth receives about 1014kW of solar energy from the sun. One square meter of the land exposed to direct sun-light receives an energy equivalent of about 1.353 kW of power. This constant may increase by only 0.2 percent at the of each 11 year solar cycle. The radiant solar energy falling on the earth surface is directly converted into thermal energy. The surfaces on which the solar rays fall are called collectors.

Insolation:-Insolation is the amount of solar radiation reaching the earth. Also called Incident Solar Radiation. Maximum value is 1000 kW/m^2.

Components of Solar Radiation:

- Direct radiation
- Diffuse radiation
- Reflect radiation

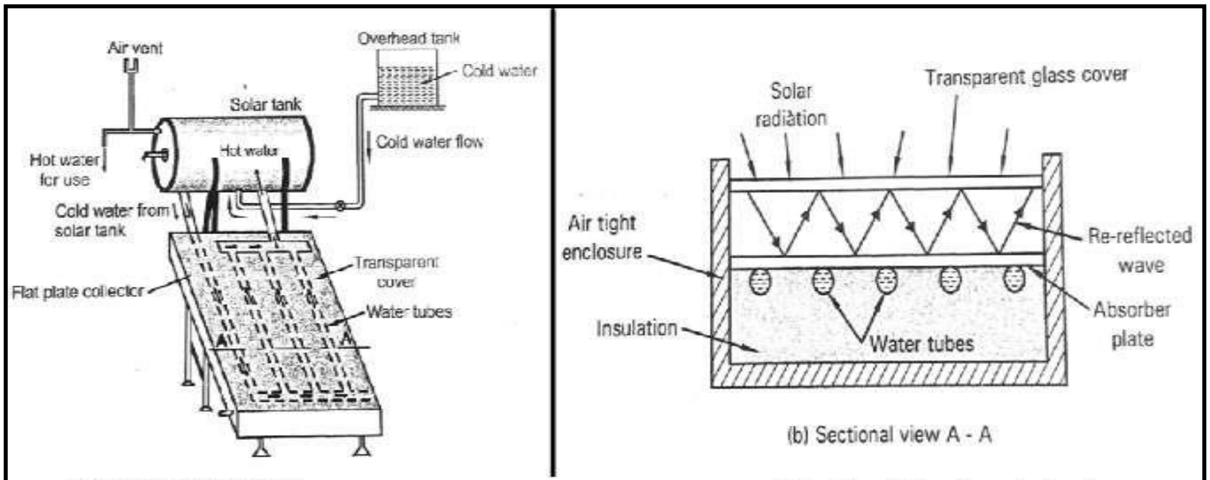
Solar Thermal Energy harvesting:

Radiant solar energy is directly converted into thermal energy (heat energy) by using a collector. This process is called as Helio thermal process. The surface on which the solar rays fall is called a collector. The collector may be either flat plate collector or focussing collector.

There are two types of collectors:

(a) Flat plate collectors (b) Focusing collectors.

LIQUID FLAT PLATE COLLECTORS:



Flat plate collector for water heating

It has the following components:

(a) Absorbing plate –

- Made of Copper, Aluminium or steel.
- It is coated with material to enhance the absorption of solar radiation.
- From the absorbing plates heat is transferred to tubes which carry either water or air.

(b) Water tubes –

- These are metallic tubes through which water circulates. Which are attached to the absorber plate.

(c) Transparent covers –

- Sheets of solar radiation transmitting materials placed above the absorbing plate.
- They allow solar energy to reach the absorbing plate while reducing convection, conduction and re-radiation heat losses.
- Made of a toughened glass, usually 4mm thick. Which helps in reflecting the incident solar

energy back to the absorber plate.

- Glass cover permits the entry of solar radiation as it is transparent for incoming short wave lengths.

(d) Insulation –

- It minimizes and protects the absorbing plate from heat losses.

Working – Sun's rays falling on the transparent covers are transmitted to the absorbing plate. The absorbing plate usually of Cu, Al or galvanized iron is painted dead black for maximum absorption. The collector (plate) will absorb the sun energy and transfer it to the fluid in the pipe beneath the collector plate. Use of flat mirrors on the sides improves the output. Water from the overhead tank is made to flow through the water tubes. Solar rays passes through the transparent cover and falls on the absorber plate. Heat energy from the absorber plate is transferred to the cold water flowing through the tubes. Worm water rises above the cold water because of low density and flows into the heater tank.

SOLAR POND TECHNOLOGY:

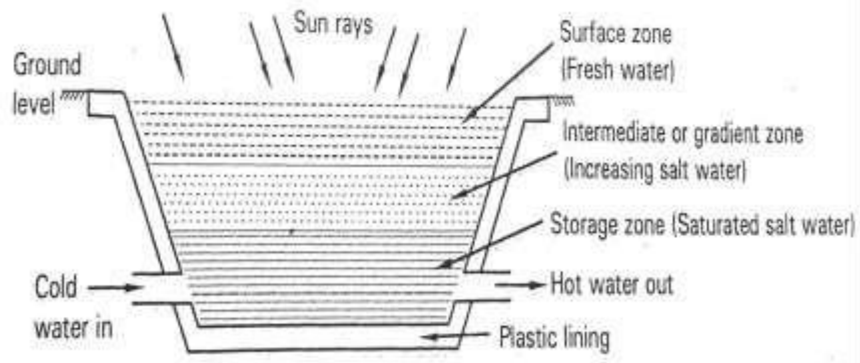


Figure 1.3 Solar pond

• A salinity gradient solar pond is an integral collection and storage device of solar energy.

• By virtue of having built-in thermal energy storage, it can be used irrespective of time and season.

• In an ordinary pond or lake, when the sun's rays heat up the water this heated water, being lighter, rises to the surface and loses its heat to the atmosphere.

• The net result is that the pond water remains at nearly atmospheric temperature.

• The solar pond technology inhibits these phenomena by dissolving salt into the bottom layer of this pond, making it too heavy to rise to the surface, even when hot.

• The salt concentration increases with depth, thereby forming a salinity gradient.

• The sunlight which reaches the bottom of the pond remains entrapped there.

• The useful thermal energy is then withdrawn from the solar pond in the form of hot brine.

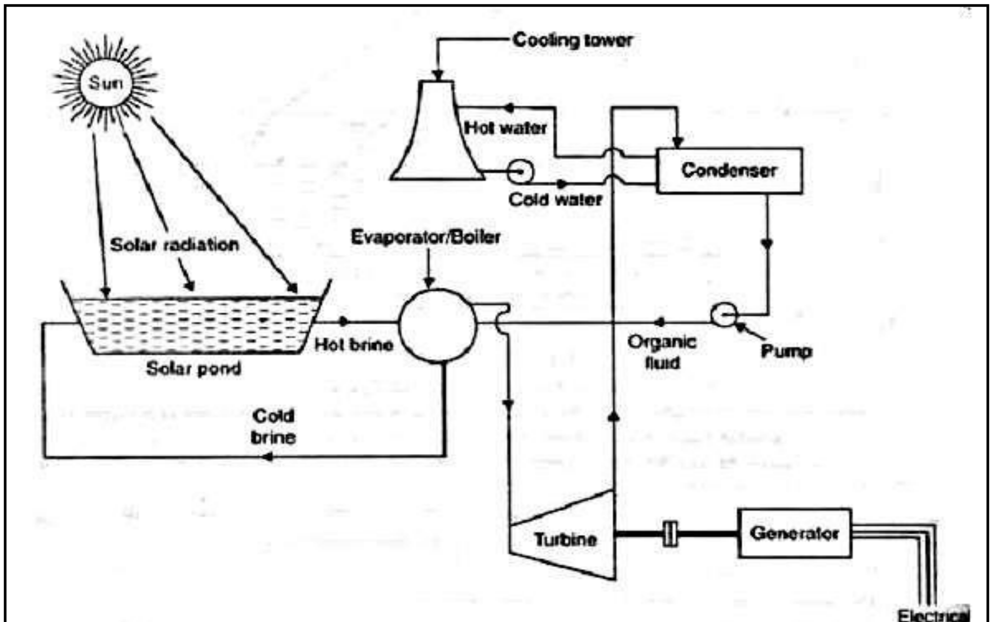
The pre-requisites for establishing solar ponds are: a large tract of land (it could be barren), a lot of sun shine, and cheaply available salt (such as Sodium Chloride) or bittern.

• Generally, there are three main layers. The top layer is cold and has relatively little salt content.

• The bottom layer is hot -- up to 100°C (212°F) -- and is very salty.

• Separating these two layers is the important gradient zone.

Solar pond electric power plant:-



solar pond electric power plant

• The energy obtained from a solar pond is used to drive a Rankine cycle heat engine.

• Hot water from the bottom level of the pond is pumped to the evaporator where the working fluid is vaporized.

• This vapour then flows under high pressure to the turbine where it expands and work thus obtained runs an electric generator producing electricity.

• The vapour is then condensed through a cooling system and the liquid is pimped back to the evaporator and the cycle is repeated.

Application of solar ponds:-

A. Heating and cooling of buildings.

B. Production of power

C. Industrial process heat.

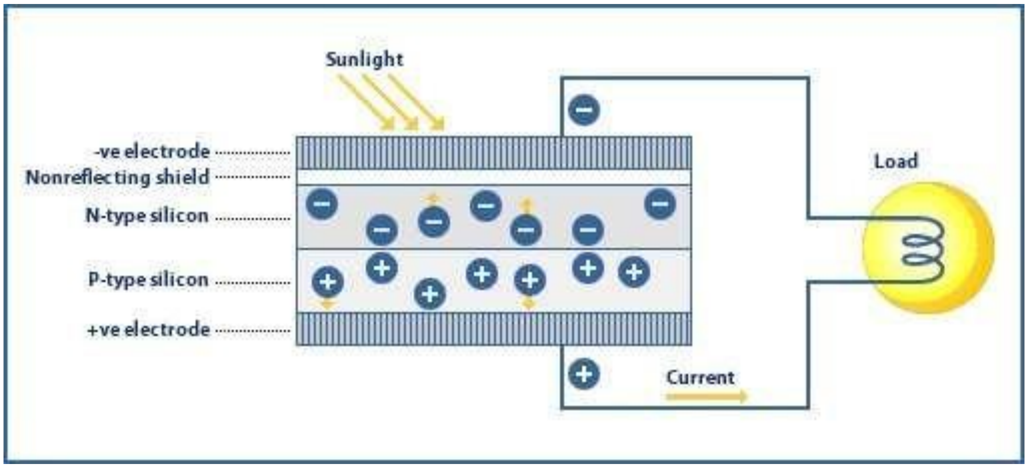
D. Heating animal housing.

E. Drying crops on farms.

PHOTOVOLTAIC CELL:

Solar energy can be directly converted to electrical energy by means of photovoltaic effect. Photovoltaic effect is defined as the generation of an electromotive force (EMF) as a result of the absorption of ionizing radiation. Devices which convert Sunlight to electricity is known as solar cells or photovoltaic cells. Solar cells are semiconductors, commonly used are barrier type iron-selenium cells.

- Iron-selenium cells consist of a metal electrode on which a layer of selenium is deposited.
- On the top of this a barrier layer is formed which is coated with a very thin layer of gold.
- The layer of gold serves as a translucent electrode through which light can impinge on the layer below.
- Under the influence of sunlight, a negative charge will build up on the gold electrode and a positive charge on the bottom electrode.
- This difference in charge will produce voltage in proportion to the suns radiant energy incident on it.

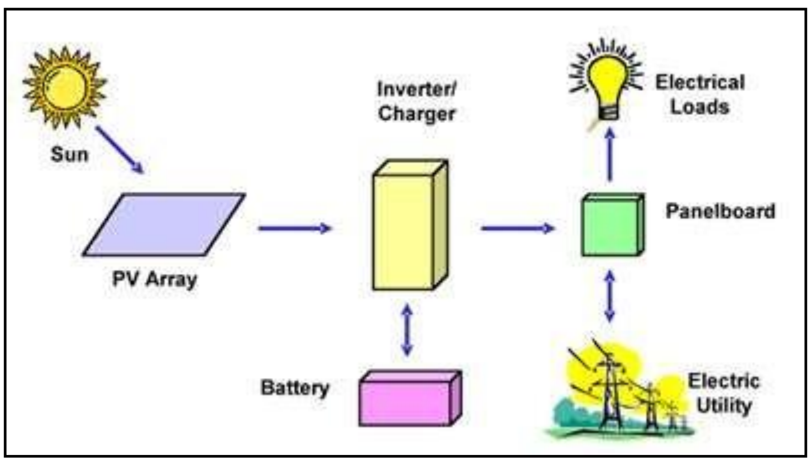


Basic photovoltaic system for power generation:

This system consists of the following:

1. Solar array (solar cells) 2. Blocking diode
3. Battery storage 4. Inverter
5. Switches and load centre

• In the solar cell array due to photovoltaic effect electrical power (D.C.) will be produced in proportion to the suns radiant energy incident on it.



This generated power will be stored in the battery storage.

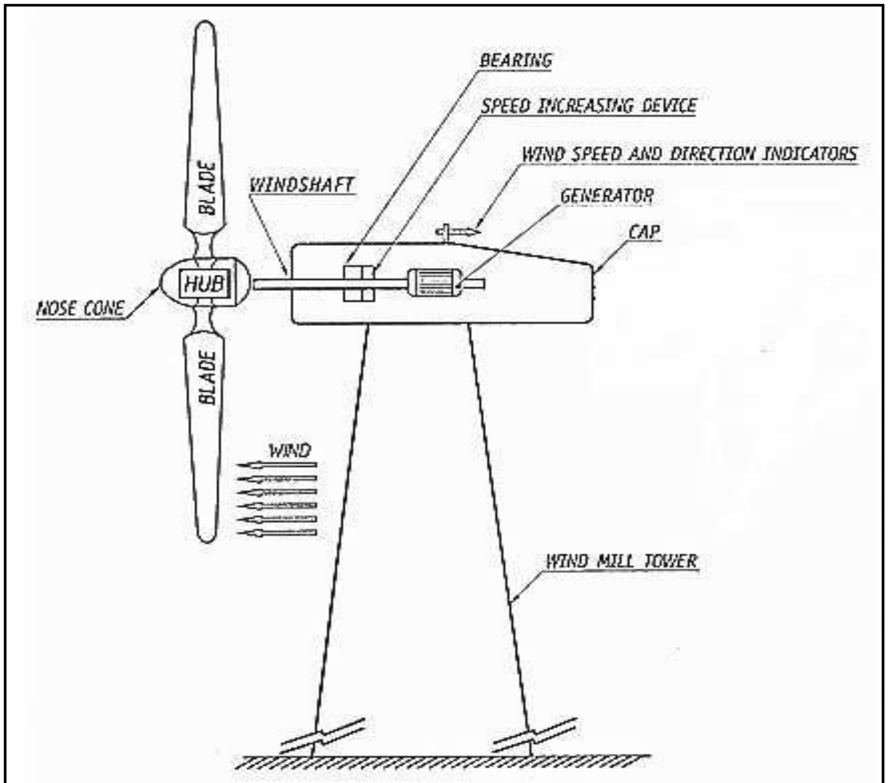
• A blocking diode ensures that the battery would not discharge power back to solar array during the period when there is no sunlight.

• An inverter converter converts the D.C power to A.C. and sends it to the load centre.

• From the load centre A.C. power is distributed accordingly with the help of switches.

WIND ENERGY:

Wind energy is the energy contained in the force of the winds blowing across the earth surface. Wind energy is defined as the kinetic energy associated with the movement of large masses of air over the earth's surface.

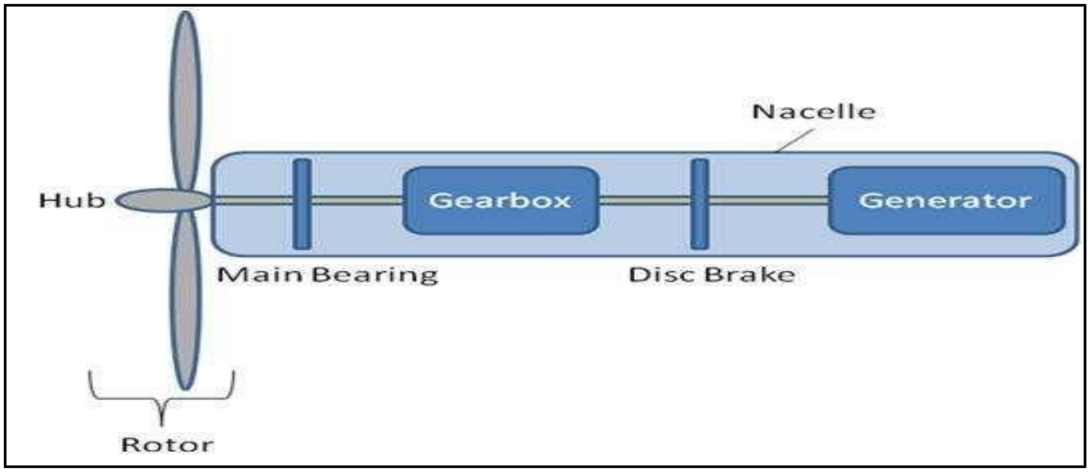


Schematic Diagram of WInd Mill

The circulation of the air in the atmosphere is caused by the non-uniform heating of the earth's surface by the sun. The air immediately above warm area expands and becomes less dense. It is then forced upwards by a cool denser air which flows in from the surrounding areas causing wind.

Wind possesses kinetic energy by virtue of its motion. Any device capable of slowing down the mass of moving air, like a sail or propeller, can extract part of this energy and convert into useful work.

The kinetic energy of one cubic meter of air blowing at a velocity V is given by, No device, however well designed can extract all the wind energy because the wind would have to be brought to halt and this through the rotor. It has been found that for maximum power output the exit velocity is equal to one-third of the entrance velocity. Thus a maximum of 60% of the available energy in the wind is converted into mechanical energy.



A windmill is the oldest device built to convert the wind energy into mechanical energy used for grinding, milling and pumping applications. It consists of a rotor fitted with large sized blades.

Merits:

1. The wind is free and with modern technology it can be captured efficiently.
2. Once the wind turbine is built the energy it produces does not cause greenhouse gases or other pollutants.
3. Many people find wind farms an interesting feature of the landscape
4. Remote areas that are not connected to the electricity power grid can use wind turbines to produce their own supply.
5. Wind turbines have a role to play in both the developed and third world.
6. Wind turbines are available in a range of sizes which means a vast range of people and businesses can use

De-merits:

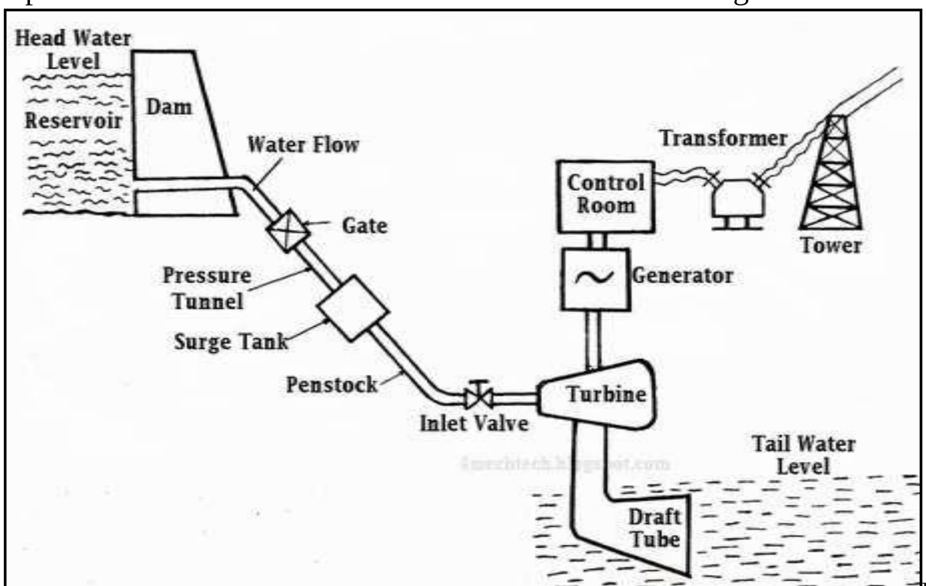
1. Wind turbines are noisy.

2. The strength of the wind is not constant and it varies from zero to storm force.

3. Only selected places it can be harnessed.

4. Hydro Power Plants:

In hydroelectric power plants the potential energy of water due to its high location is converted into electrical energy. The total power generation capacity of the hydroelectric power plants depends on the head of water and volume of water flowing towards the water turbine.



The hydroelectric power plant, also called as dam or hydro power plant, is used for generation of electricity from water on large scale basis. The dam is built across the large river that has sufficient quantity of water throughout the river. In certain cases where the river is very large, more than one dam can built across the river at different locations. The rain water flowing as river can be stored behind dams and released in a regulated way to generate hydro power.

Working Principle of Hydroelectric power plant

The water flowing in the river possesses two type of energy:

(1) The kinetic energy due to flow of water and

(2) Potential energy due to the height of water.

In hydroelectric power and potential energy of water is utilized to generate electricity the formula for total power that can be generated from water in hydroelectric power plants due to its height is given.

The potential energy of water stored at a height is converted into mechanical energy in water turbine. The mechanical energy produced by the water turbine is converted into electrical energy. After doing useful work water is discharged from the turbine to the river through a water to the tail race through a draft tube.

Merits: - environmental friendly source, large scale power generation, energy at free of cost.

Demerits: - expensive to build the dam, summer water may not sufficient to produce electricity.

NUCLEAR POWER:-

Nuclear energy is the energy that holds the nucleus of an atom. The energy released during nuclear fission or fusion, especially when used to generate electricity.

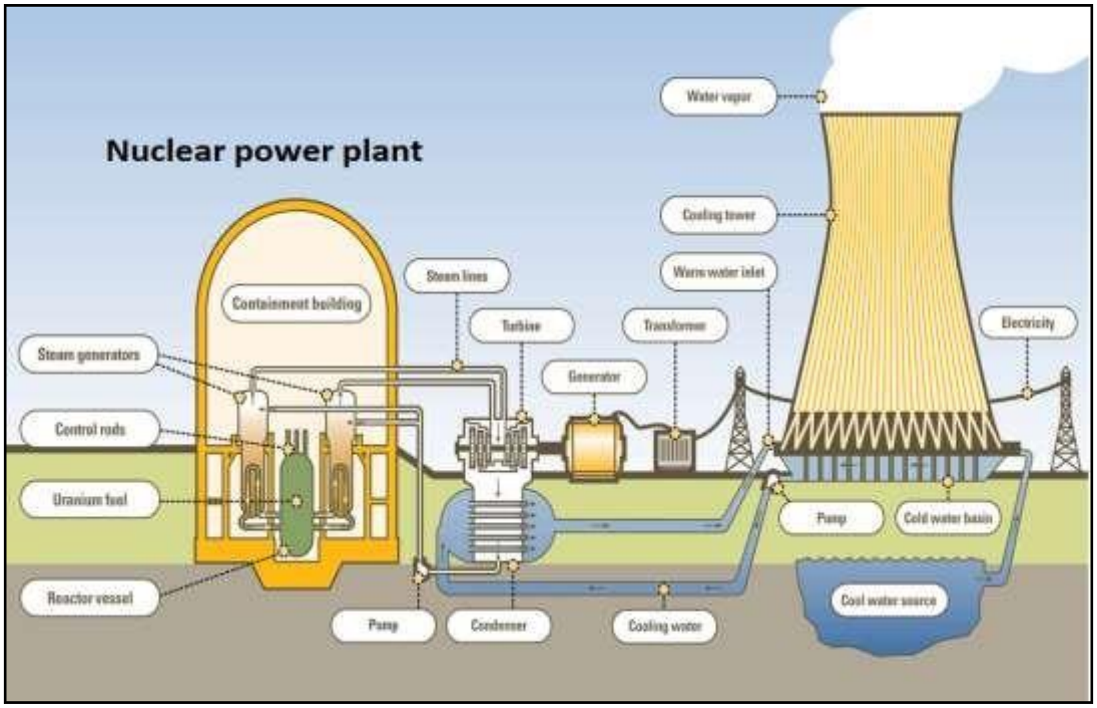
Nuclear Fission: - Nuclear fission is the process of splitting a nucleus into two nuclei with smaller masses. Fission means “to divide”.

“The most common nuclear fuels are 235U. Not all nuclear fuels are used in fission chain reactions”

Chain Reaction: - A chain reaction is an ongoing series of fission reactions. Billions of reactions occur each second in a chain reaction.

- On earth, nuclear fission reactions take place in nuclear reactors, which use controlled chain reactions to generate electricity.
- Uncontrolled chain reactions take place during the explosion of an atomic bomb.

Nuclear Fusion: - Nuclear fusion is the combining of two nuclei with low masses to form one nucleus of larger mass. Nuclear fusion reactions are also called thermonuclear reactions.



Working principle of a nuclear power station

The schematic diagram of nuclear power station is shown in A generating station in which nuclear energy is converted into electrical energy is known as nuclear power station.

The main components of this station are nuclear reactor, control rods, steam generators, steam turbine, coolant pump, feed pump, condenser, cooling tower.

NUCLEAR REACTOR:- A nuclear reactor is a device in which nuclear chain reactions are initiated, controlled, and sustained at a steady rate, as opposed to a nuclear bomb, in which the chain reaction occurs in a fraction of a second and is uncontrolled causing an explosion.

CONTROL RODS: - Control rods made of a material that absorbs neutrons are inserted into the bundle using a mechanism that can rise or lower the control rods. The control rods essentially contain neutron absorbers like, boron, cadmium or indium.

STEAM GENERATORS: - Steam generators are heat exchangers used to convert water into steam from heat produced in a nuclear reactor core. Either ordinary water or heavy water is used as the coolant.

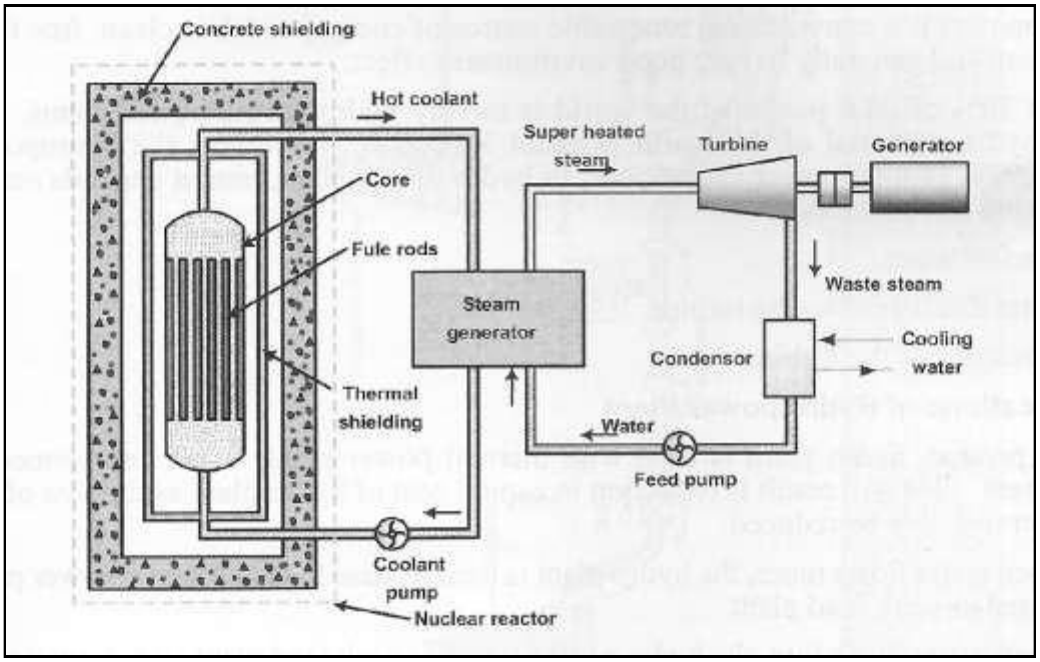
STEAM TURBINE: - A steam turbine is a mechanical device that extracts thermal energy from pressurized steam, and converts it into useful mechanical. Various high-performance alloys and super alloys have been used for steam generator tubing.

COOLANT PUMP: - The coolant pump pressurizes the coolant to pressures of the order of 155bar. The pressure of the coolant loop is maintained almost constant with the help of the pump and a pressurizer unit.

FEED PUMP: - Steam coming out of the turbine, flows through the condenser for condensation and recirculated for the next cycle of operation. The feed pump circulates the condensed water in the working fluid loop.

CONDENSER: - Condenser is a device or unit which is used to condense vapor into liquid. The objective of the condenser are to reduce the turbine exhaust pressure to increase the efficiency and to recover high quality feed water in the form of condensate & feedback it to the steam generator without any further treatment.

COOLING TOWER: - Cooling towers are heat removal devices used to transfer process waste heat to the atmosphere. Water circulating through the condenser is taken to the cooling tower for cooling and reuse The reactor of a nuclear power plant is similar to the furnace in a steam power plant. The heat liberated in the reactor due to the nuclear fission of the fuel is taken up by the coolant circulating in the reactor. A hot coolant leaves the reactor at top and then flows through the tubes of heat exchanger and transfers its heat to the feed water on its way. The steam produced in the heat exchanger is passed through the turbine and after the work has done by the expansion of steam in the turbine, steam leaves the turbine and flows to the condenser. The mechanical or rotating energy developed by the turbine is transferred to the generator which in turn generates the electrical energy and supplies to the bus through a step-up transformer, a circuit breaker, and an isolator. Pumps are provided to maintain the flow of coolant, condensate, and feed water.



ADVANTAGES:-

- Nuclear power generation does emit relatively low amounts of carbon dioxide (CO2).
- The emissions of greenhouse gases and therefore the contribution of nuclear power plants to global warming is therefore relatively little.
- This technology is readily available, it does not have to be developed first.
- It is possible to generate a high amount of electrical energy in one single plant.

DISADVANTAGES:-

- The problem of radioactive waste is still an unsolved one.
- High risks: It is technically impossible to build a plant with 100% security.
- The energy source for nuclear energy is Uranium. Uranium is a scarce resource, its supply is estimated to last only for the next 30 to 60 years depending on the actual demand.

TURBINES or Prime mover– Is a self-moving device which converts available natural source of energy into mechanical energy of motion to drive the other machines. The resulting mechanical energy will be in the form of rotation of the shaft of prime mover.

Depending upon the type of natural source of energy used prime movers are classified into

1) Thermal Prime movers
    a) Steam turbines
    b) Gas Turbines
    c) I.C. Engines
2) Hydraulic Prime movers
    a) Pelton Wheel
    b) Kaplan Turbine
    c) Francis Turbine

Steam turbines

A steam turbine is a prime mover that extracts thermal energy from pressurized steam and converts it into useful mechanical work.

Steam turbines are primarily used to run alternators or generators in thermal power plants. It is also used to rotate the propeller of ships.

Classification of Steam Turbine

Steam turbines can be classified into two types

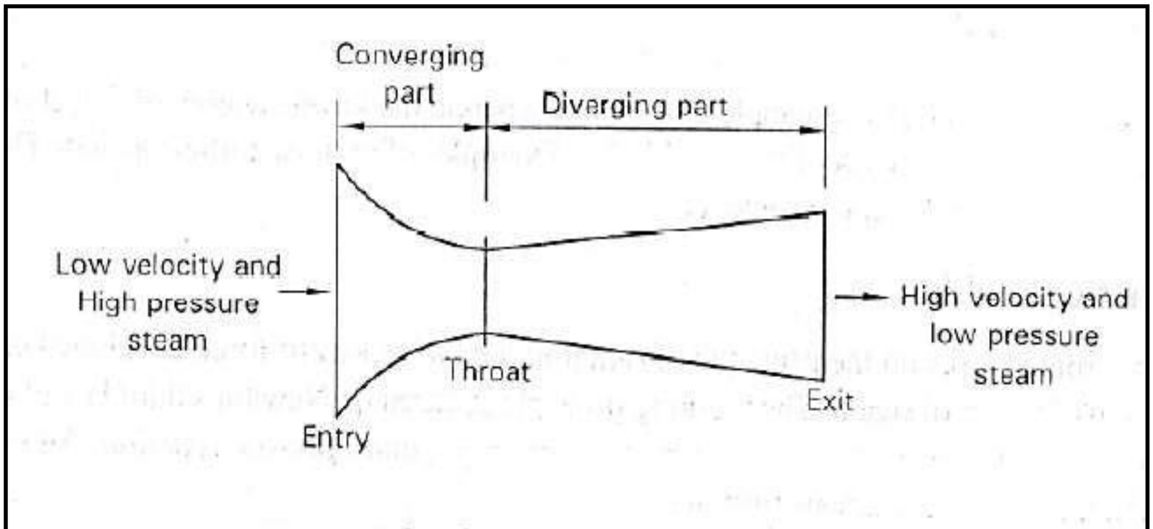
a) Impulse turbine.

b) Reaction turbine.

EXPANSION OF STEAM IN THE NOZZLE:

A nozzle is a passage of varying cross-section through which steam flows. Figure shows a convergent-divergent nozzle in which the cross-sectional area of the nozzle diminishes from the entry to throat, and thereafter diverges to the exit as shown in the figure.

Steam is expanded in a nozzle to increase its kinetic energy. The high pressure and low velocity steam generated in a boiler enters the nozzle, and as it passes between the entry and



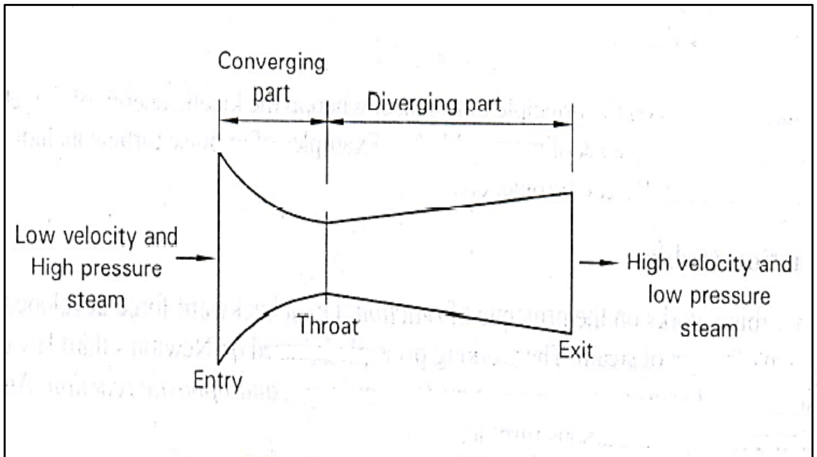
Convergent – Divergent nozzle

the throat, the pressure of the steam drops to a lower value. In other words, steam expands to a low pressure. This drop in pressure reduces the enthalpy (heat content) of steam.

Since there is no external work and heat transfer in the nozzle, the reduction in the enthalpy of steam must be equal to the increase in velocity (kinetic energy) of the steam. In other words, the steam performs work upon itself by accelerating itself to a high velocity. Hence, the steam comes out of the nozzle with low pressure, and high velocity. Beyond the throat, the nozzle diverges to a certain length, so as to allow any incomplete expansion of the steam to take place.

a) Impulse Turbine (De-Laval).

In this type of turbine, the steam is initially expanded in a nozzle. The high velocity jet of steam coming out of the nozzle is made to glide over a curved vane called blade. From fig we found that the jet of steam gliding over the blade gets deflected this causes the particle of steam to suffer a change in direction of motion which gives rise to change in momentum and therefore a force. The resultant of these forces acting on entire curved surface of blade causes it to move. When a number of such blades are fitted on the circumference of a revolving wheel, called rotor as shown in figure they will be moved by the action of steam.



Convergent – Divergent nozzle

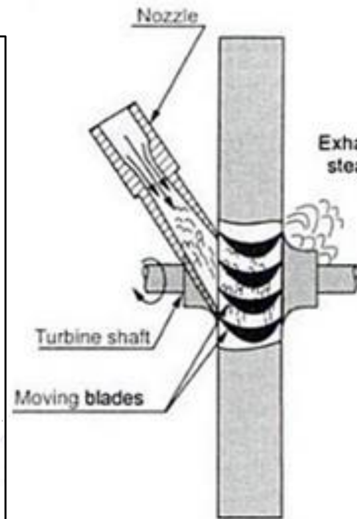


Fig. Impulse Turbine

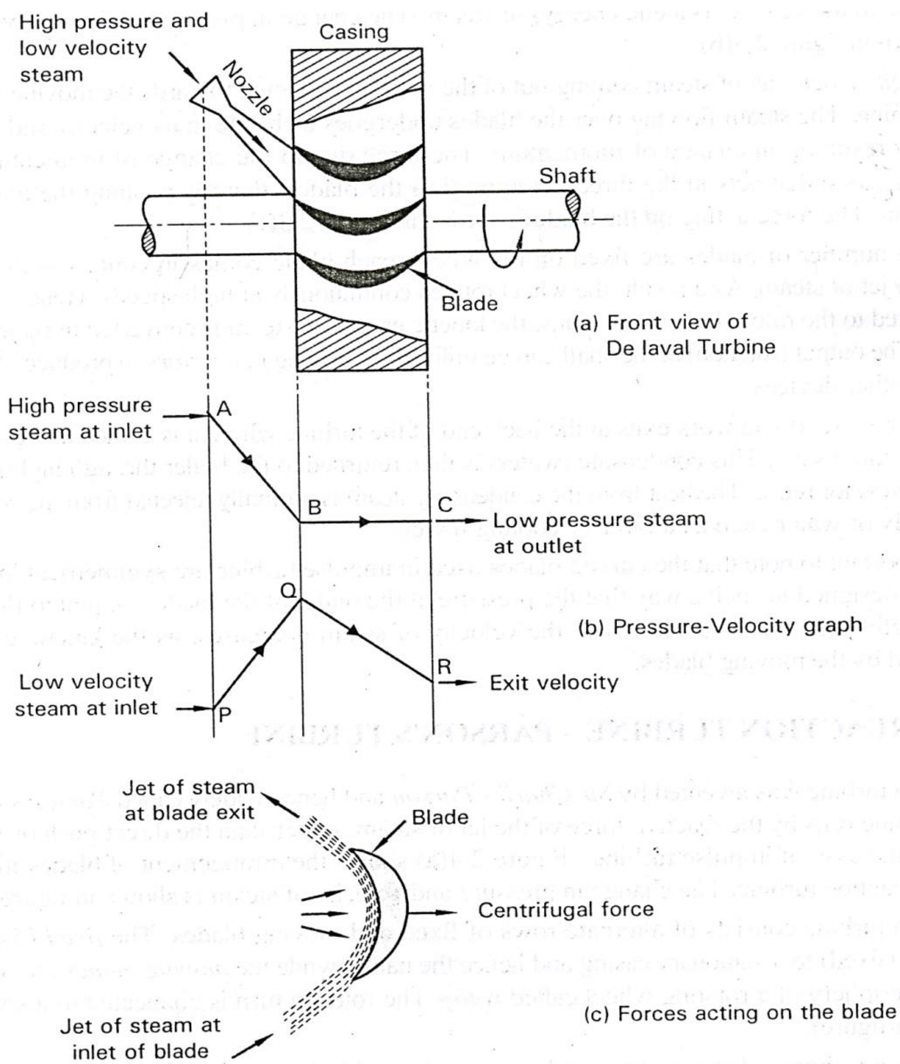


Fig. Pressure-velocity diagram

At entry of steam at nozzle, velocity of steam is low V_L having high pressure energy P_H. In nozzle, pressure of steam drops and increase in velocity of steam takes place. Across the blades, pressure remains constant and velocity drops suddenly as shown in Pressure-velocity diagram.

b) Reaction turbine (Parson's turbine)

The reaction turbine, as the name implies, is turned by reactive force rather than by a direct push or impulse. In reaction turbines, the blades that project radially from the periphery of the rotor are formed and mounted so that the spaces between the blades will have the nozzle shape. Since these blades are mounted on the revolving rotor, they are called moving blades. Fixed or stationary blades of the same shape as the moving blades are fastened to the casing in which the rotor revolves. The fixed blades guide the steam into the moving blade.

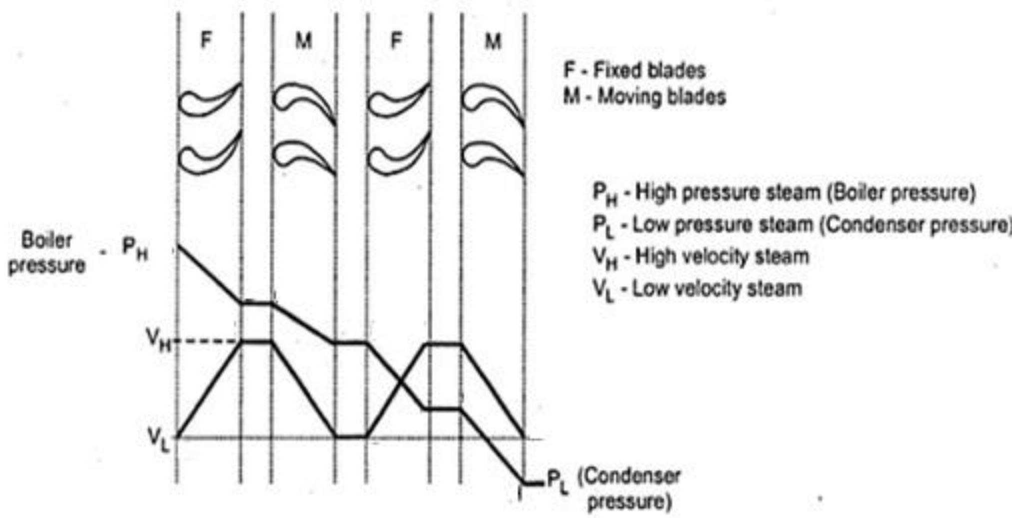


Fig. Pressure-velocity diagram

When high pressure steam P_H passes over the fixed blades, causing drop in pressure and increase in velocity V_H, in moving blades pressure further reduces along with velocity as shown in Pressure-velocity diagram. For next set, in fixed blades pressure further gets reduced with increase in velocity. In moving blades pressure still reduced to condenser pressure reducing the velocity.

- **Comparison of Impulse turbine and Reaction turbine**

Impulse turbine	Reaction turbine

Complete expansion of steam takes place in the nozzle.	Partial expansion of steam takes place in the fixed blades and further expansion takes place in the moving blades.
Blades are symmetrical in shape.	Blades are non-symmetrical in shape i.e., aerofoil section.
The rotor runs at higher speeds.	The rotor runs at relatively low speed.
The impulse turbines are used for small power generation plant.	The reaction turbines are used in large power generation plant.
Less floor area is required.(small power plant).	More floor area is required. (Medium and large power plant).
The pressure of steam remains constant from inlet to the outlet of the blade.	The pressure of steam drops from inlet to the outlet of the blade.

Gas Turbines

Gas turbine is used in wide range of applications like, aircraft, industrial, ship and power generation plants. In the gas turbine plant, the atmospheric air is drawn and is compressed to a high pressure, the fuel is injected to the compressed air, the fuel burns and the energy is released, the energy is utilized to rotate a turbine. The heat transfer to the working fluid may be through direct contact or through indirect heating without any change in the composition of the working fluid

- **Classification of Gas Turbines**

a) Open cycle gas turbine. b) Closed cycle gas turbine.

a) Open Cycle Gas Turbine

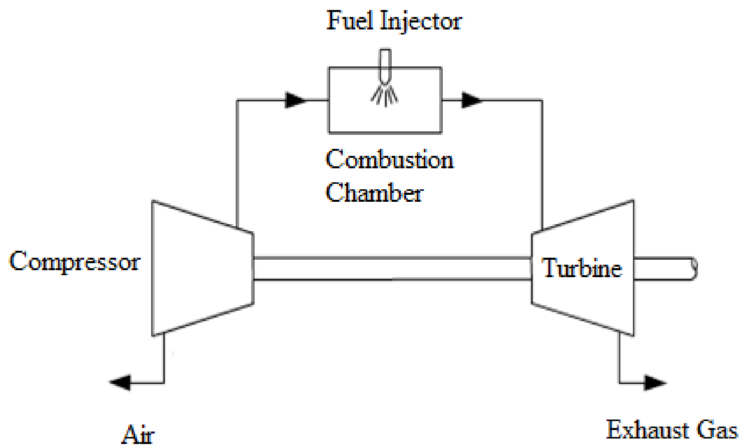


Fig. Open-cycle gas turbine

A compressor which draws air at atmospheric pressure and compress the air and delivered to a combustion chamber at high pressure. The fuel (liquid or gas) is injected into a stream of high-pressure air and the combustion takes place in a combustion chamber. The combustible gases release tremendous amount of energy, which is used to rotate a turbine. The exhaust gases from the turbine are led to the atmosphere. The exit gas from the turbine is not recycled back to the compressor hence it is known as open cycle gas turbine. In open cycle gas turbine, every cycle fresh air enters the compressor.

b**) Closed Cycle Gas Turbine**

The schematic representation of closed cycle gas turbine is shown in figure. The compressed air from the compressor passes through the heater by means of external source, where heat transfer takes place at constant pressure. The high pressure and temperature gases are then passed through the turbine where it expands to lower pressure driving turbine shaft producing mechanical work. The exit gases from the turbine is cooled to ambient temperature in heat exchanger (cooler), this cooled gas fed back to the compressor for the next cycle. Thus, the same working fluid is circulated through the cycle.

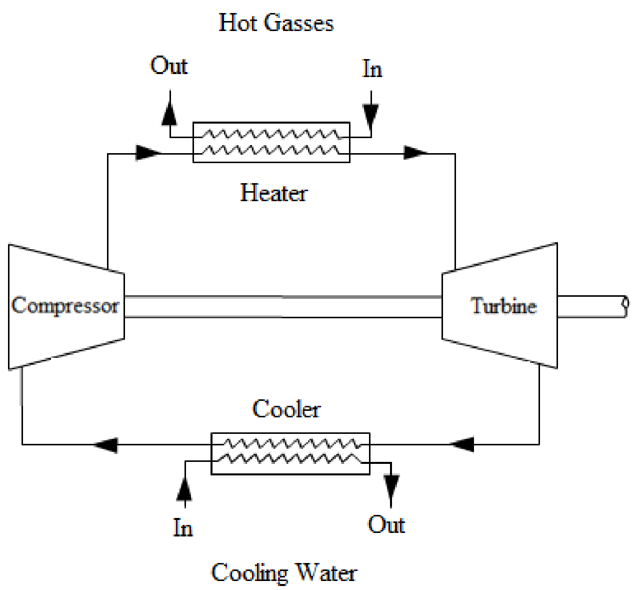


Fig. Closed Cycle Gas Turbine

- **Comparison of Open Cycle and Closed Cycle Gas Turbines**

Closed cycle	**Open cycle**
Working substance is continuously re-circulated	Working substance is continuously replaced in every cycle
Any fluid may be used as the working substance	The working substance comprises of the mixture of air and the products of combustion of fuel
There is only heat and work transfer takes place between the system and surrounding	There is mass transfer taking place in addition to heat and work transfer between system and surrounding
There is no loss of working substance	In every cycle fresh air is drawn
It requires a cooling medium, which is usually water.	The hot exhaust gases are let to the atmosphere ad there is no need of any cooling medium.

Water Turbines / Hydraulic Turbines

A hydraulic turbine is a prime mover, which converts Kinetic energy and Potential energy of water into mechanical rotary motion.

WATER TURBINES

A water turbine is a hydraulic prime mover that converts the energy of falling water into mechanical energy in the form of rotation of shaft. The mechanical energy in turn is converted into electrical energy by means of an electric generator.

Water turbines are classified based on the following factors:

<u>Type of energy available at the inlet of the turbine:</u>

(a) Impulse turbine: The energy available at the inlet of the turbine is only kinetic energy.

Example: Pelton wheel, Girad turbine, Banki turbine, etc.

(b) Reaction turbine: Both pressure energy and kinetic energy is available at the inlet of the turbine.

Example: Kaplan turbine, Francis turbine, Thomson turbine, etc.

<u>Based on the head under which turbine works:</u>

a) **High head turbine:** Head of water available at the inlet of the turbine ie, above 300 m. Example: Pelton wheel.

b) **Medium head turbine:** Head of water available at the inlet of the turbine ranges from 50 m to 150 m. Example: Francis turbine.

c) **Low head turbine**: Head of water at the inlet will be less than 50m. Example: Kaplan Turbine.

<u>Based on the direction of flow of water through the runner:</u>

a) **Tangential flow turbine:** Water flows along the tangent to the runner. Example: Pelton wheel.

b) **Axial flow turbine:** Water flows in a direction parallel to the axis of rotation of the runner. Example: Kaplan turbine.

c) **Radial flow turbine:** Water flows in a radial direction through the runner. Radial flow turbines are further classified into inward radial flow and outward radial flow turbines. Example: Thomson turbine, Girad turbine, Old Francis turbine.

d) **Mixed flow turbine**: Water flows racially into the runner and leaves axially, Example: Modern Francis turbine.

a) Impulse Turbine

In an impulse turbine the pressure energy of water is converted into kinetic energy in a nozzle before it enters the turbine casing. The nozzle provides a high-velocity jet of water which is made to strike the blades mounted on the periphery of the rotor of turbine. As the water flows over the blades an impulse force is generated which drives the rotor.

Example: Pelton Wheel

- **Pelton Wheel**

Pelton wheel is the most commonly used type of impulse turbine. A pelton wheel consists of a rotor mounted on the turbine shaft. On the circumference of the rotor several bucket shaped blades are radially fitted. The water flowing through the nozzle is converted into the high velocity jet of water when flows over the blades sets up an impulse force which causes the blades to move. Thus, the kinetic energy of the water is converted into the rotation of the turbine shaft. Since the rotational speed of the pelton wheel is extremely high breaking jets are employed for the speed control as shown in figure. The nozzle is provided with spear needle to adjust the flow rate of water into the turbine depending upon the requirement.

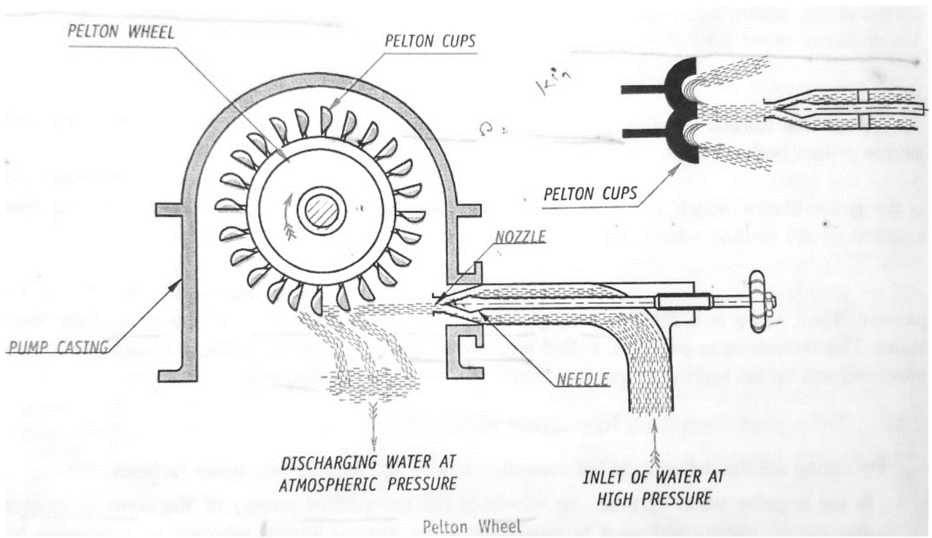


Fig. Pelton Wheel

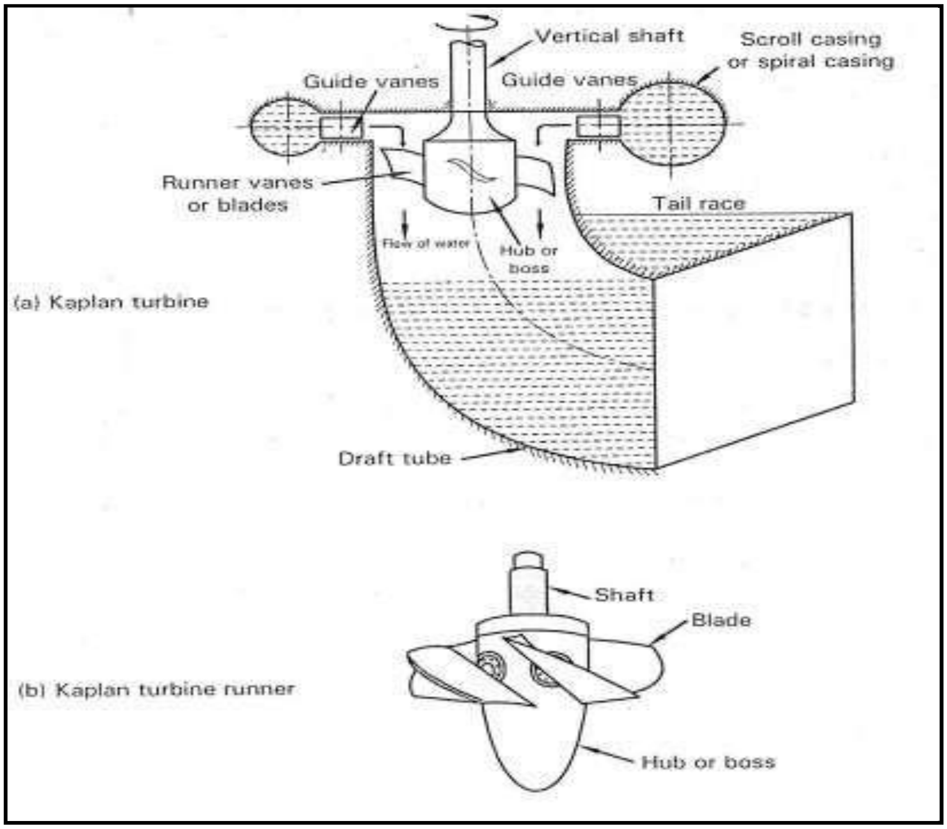
b**) Reaction Turbines**

In reaction turbine only a part of the total available energy at the inlet is converted into kinetic energy before it reaches the turbine rotor. Here the water first passes through the guide blades which guide or deflect the water to enter the moving blades where it's part of kinetic energy is converted into kinetic energy which is absorbed by the turbine rotor. Reaction turbines are used in low and medium head applications.

Example: Francis and Kaplan Turbines

1) KAPLAN TURBINE

The Kaplan turbine is a low head reaction turbine in which water flows axially, Figure shows the rotor and front view of a Kaplan turbine. Kaplan turbine consists of the following parts: guide vanes, runner vanes, shaft, spiral casing, tailrace, hub, and blade.


Vertical shaft
Scroll casing
or spiral casing
Guide vanes
Guide vanes
Runner vanes
or blades
Tail race
Flow of water
Hub or
boss
(a) Kaplan turbine
Draft tube
Shaft
Blade
(b) Kaplan turbine runner
Hub or boss

Working:

Kaplan turbine is an axial flow reaction turbine and is used where large quantity of water is available at low heads. The turbine consists of a hub or boss fixed to a vertical shaft. The runner blades attached to the hub are adjustable, and can be turned about their axis to take care of change of load. The runner has only 4 to 8 blades. Similar to Francis turbine, Kaplan turbine also has a ring of fixed guide blades at the inlet to the turbine. The inlet is a scroll shaped tube surrounding the fixed blades. In operation, water from the reservoir flows through the penstock and enters the spiral casing. A part of the potential energy of water is converted into kinetic energy in the spiral casing.

The water then moves through the guide blades (fixed blades), gets deflected and then flows axially through the runner blades as shown in figure. During its flow over the runner blades, the blade passages act as nozzle, and the remaining part of the potential energy is converted into kinetic energy. The water leaves the runner blades at high velocity, and as a result, a reaction force is set up causing the runner to rotate at high speeds. Hence the shaft connected to the runner also rotates thereby doing useful work. The shaft in turn drives the generator to produce electricity. The water discharging at the centre of the runner enters the draft tube whose end is immersed into the tailrace as in Francis turbine.

Advantages:

1) Simple in construction and requires less space.

2) Eddy losses are almost eliminated.

Disadvantages:

1) Cavitation is likely to occur due to high velocity flow of water.

Difference between impulse water turbine and reaction water turbine:

SI No.	**Reaction Water Turbine**	**Impulse Water Turbine**
1.	Reaction turbines are used for low and medium heads. Example Francis and Kaplan turbine.	Impulse turbines are used for high heads. Example Pelton turbine
2.	Pressure drop occurs in both fixed and moving blades.	No pressure change occurs at the turbine blades
3.	Part of the pressure energy is converted to kinetic energy in the spiral casing, and the remaining in the blade passages that acts as nozzle.	Pressure energy is completely converted to kinetic energy in a nozzle.
4.	Reaction turbines rotate faster given the same head and flow conditions.	Comparatively low.

5.	Reaction turbines require more sophisticated fabrication because of the use of larger and more intricately profiled blades and casings.	Comparatively ease in fabrication.
6.	Reaction turbines must be encased to contain the water pressure (or suction), or they must be fully submerged in the water flow.	Relatively not necessary

Difference between Francis and Kaplan turbine:

Sl no	Francis turbine	Kaplan turbine
1	It is a mixed flow turbine	It is an axial flow turbine
2	Medium head turbine, requires medium quantity of water	Low head turbine, requires large quantity of water
3	Number of guide vanes are around 16 to 24	Number of guide vanes are around 3 to 8
4	The runner is supported by a driving shaft	The runner is the extension of the vertical shaft
5	Guide vanes are assembled with the help of links and levers to act as valves	Guide vanes are made adjustable for smooth flow of water. They are so designed and fixed around the hub
6	Requires large space	Requires less space due to sloped vanes
7	Eddy losses are impossible to avoid	It is almost eliminated
8	Cavitation do not occurs	Cavitation is likely to occur
9	Draft tube is of simple elbow type	Draft tube is of circular to rectangular type

Fig. Kaplan turbine

- **Comparison of Impulse and Reaction Water Turbine**

Impulse Turbine	Reaction Turbine
Available energy is completely converted into kinetic energy in the nozzle.	The available energy is Partially converted into kinetic energy in the fixed blade and partially in the moving blades.
The water comes out from the nozzle and directly impinges on the runner.	In reaction turbine, water first enters the fixed blades and then enters the moving blades.
The pressure of the water flowing from inlet to the outlet of runner remains constant (atmospheric pressure).	The pressure of the water reduces while flowing from inlet to the outlet of runner (less than atmospheric).
Turbine can be installed above the tail race.	Turbine is submerged in water below tail race.
Casing is provided to prevent splashing of water.	Airtight casing is provided to prevent the pressure leakage.
Power developed is mainly due to kinetic energy.	Power developed is partly by change in kinetic energy and partly due to pressure energy.
Impulse turbine requires high head.	Reaction turbine requires low head.

MODULE 2:

IC ENGINES, REFRIGERATION & AIR CONDITIONING

IC Engines

I. C. Engines: An Internal combustion engine more probably called as IC Engine, is a heat engine which converts heat energy released by the combustion of fuel taking place inside the engine cylinder into mechanical work. It has advantages such as high efficiency, light weight, compactness, easy starting, adaptability, suitability for mobile applications, comparatively lower initial cost has made its use as a prime mover.

Classification of IC Engines:

i. Nature of Thermodynamic cycle as:

1. Otto Cycle engine. 2. Diesel engine. 3. Dual combustion cycle engine.

ii. Type of Fuel used as:

1. Petrol Engine 2. Diesel engine. 3. Gas engine. 4. Bi-fuel engine.

iii. Number of strokes as:

1. Four stroke engine. 2. Two stroke engine.

iv. Method of ignition as:

1. Spark ignition engine, known as S.I engine.
2. Compression ignition engine, known as C.I. Engine.

v. Number of cylinders as:

1. Single cylinder engine. 2. Multi cylinder engine.

vi. Position of Cylinder as:

1. Horizontal engine. 2. Vertical engine. 3. V- engine. 4. Opposed cylinder engine

5. Radial engine.

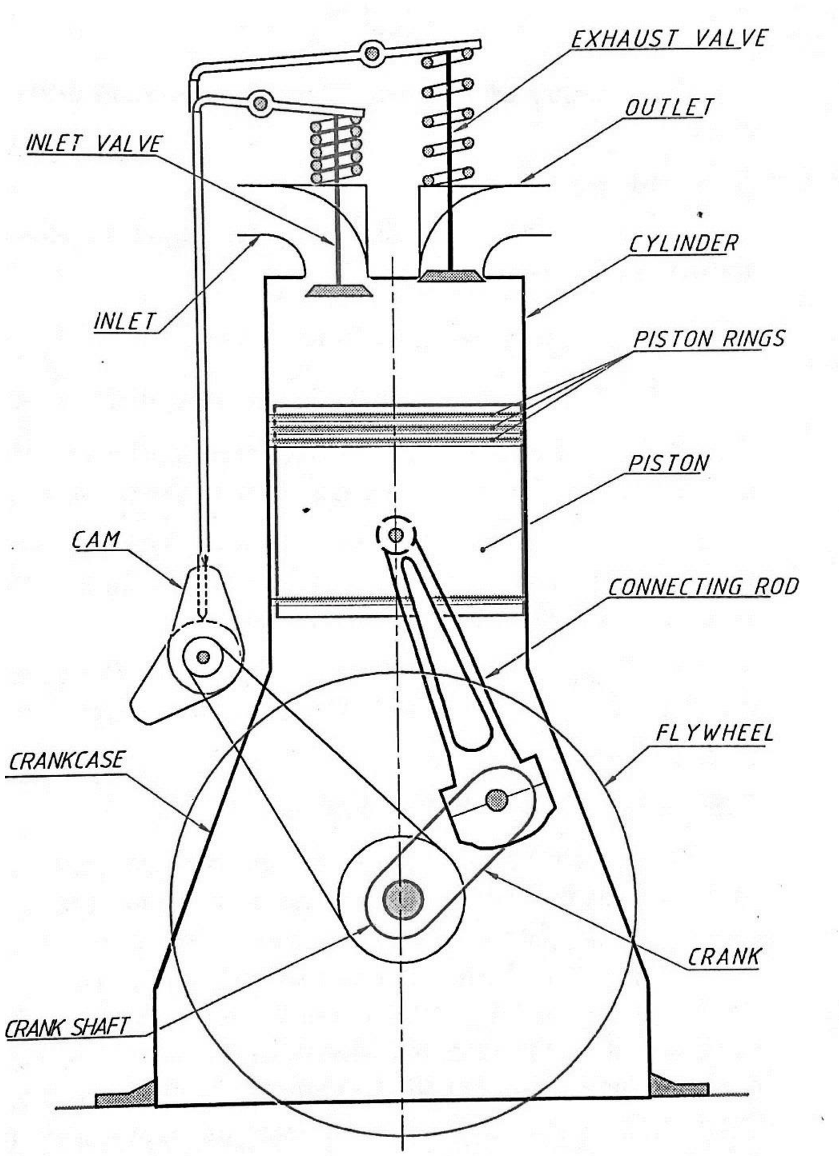
vii. Method of cooling as:

1. Air cooled engine. 2. Water cooled engine.

Parts of I.C. Engines:

Cylinder: The heart of the engine is the cylinder in which the fuel is burnt and the power is developed. The inside diameter is called bore. To prevent the wearing of cylinder block, a sleeve will be fitted tightly in the cylinder. The piston reciprocates inside the cylinder.

Piston: The piston is a close fitting hollow cylindrical plunger moving to-and-fro in the cylinder. The power developed by the combustion of the fuel is transmitted by the piston to the crankshaft through the connecting rod.



Parts of I.C.Engine

ELEMENTS OF MECHANICAL ENGINEERING: MODULE 3

Piston rings: The piston rings are the metallic rings inserted into the circumferential grooves provided at the top end of the piston. These rings maintain a gas-tight joint between the piston and the cylinder while the piston is reciprocating in the cylinder. They also help in conducting the heat from the piston to the cylinder.

Connecting rod: It is a link that connects the piston and the crankshaft by means of pin joints. It converts the rectilinear motion of the piston into rotary motion of the crankshaft.

Crank and crankshaft: The crank is lever that is connected to the end of the connecting rod by a pin joint with its other end rigidly connected to a shaft called crankshaft. It rotates about the axis of the crankshaft and causes the connecting rod to oscillate.

Crank case: It is the lower part of the engine serving as an enclosure for the crankshaft and also sump for the lubricating oil.

Valves: The valves are the devices which controls the flow of the intake and the exhaust gas to and from the cylinder. They are also called poppet valves. These valves are operated by means of cams driven by

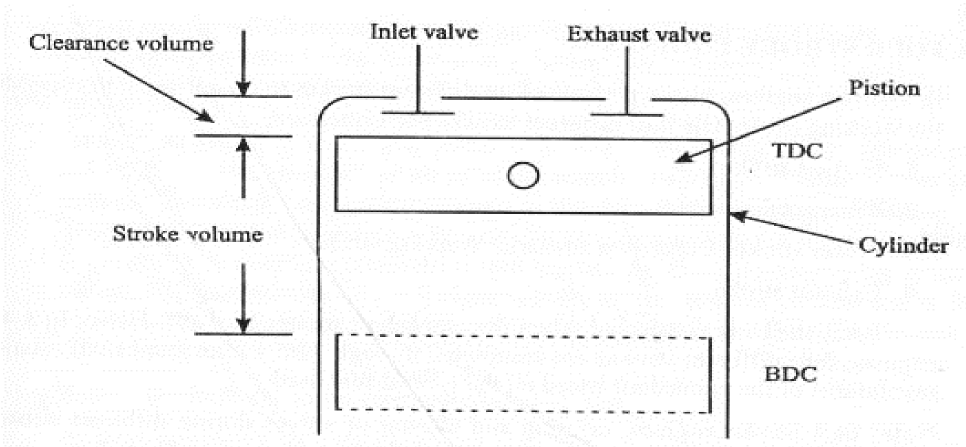
2

ELEMENTS OF MECHANICAL ENGINEERING: MODULE 3

crankshaft through a timing gear and chain.

Fly wheel: It is a heavy wheel mounted on the crankshaft of the engine to maintain uniform rotation of the crankshaft.

I.C. Engine Terminology:



Stroke: It is the distance travelled by the piston from the cover end to the crank end or from crank end to the cover end. It is denoted by L.

Bore: It is the diameter of the cylinder or outer diameter of the piston. It is denoted by D.

Top dead centre (TDC) or cover end: It is the extreme position of the piston, when the piston is near cylinder head.

Bottom dead centre (BDC) or crank end: It is the extreme position of the piston, when the piston is near the crankshaft end.

Swept volume (V_S): It is the volume covered by the piston when the piston moves from TDC to BDC. It is denoted by V_S and is given by,

$$V_S = \frac{\pi D^2}{4}$$

Clearance volume (V_C): It is the volume occupied by the charge at the end of compression stroke when the piston is at TDC.

Compression ratio (C.R): It is the ratio of total volume of the cylinder to the clearance volume. i.e., CR or r = Total volume/clearance volume.

$$r = \frac{V_T}{\quad} = \frac{V_S+V_C}{\quad}$$

V_C V_C

Piston speed: The total linear distance travelled by the piston per unit time is called piston speed. It is expressed in m/min and is given by,

Piston speed = *2LN m/min*

L = length of stroke in *m*

N = speed of the engine in *rpm*.

3

ELEMENTS OF MECHANICAL ENGINEERING: MODULE 2

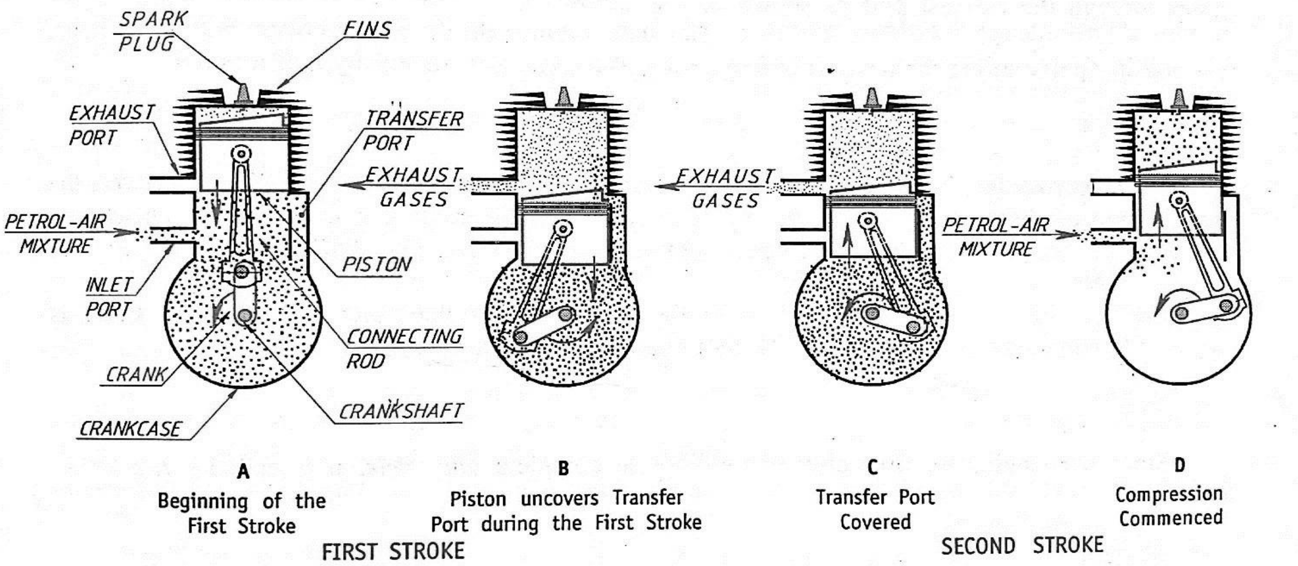
Two - Stroke Engine:

A 2 stroke engine performs only TWO strokes to complete one cycle. Crankshaft makes only one revolution to complete the cycle. The power is developed in every revolution of the crankshaft. Based on the type of fuel used they are classified as **2-Stroke Petrol** engine and **2 Stroke Diesel** Engine.

Two-Stroke Petrol Engine:

- Inlet port – admits fresh air-fuel mixture (charge) into the crankcase.
- Transfer port – transfers the charge from the crankcase into the cylinder.
- Exhaust port – discharges the burnt gases from the cylinder.

These ports are opened and closed by the reciprocating piston. The connecting rod and the crank convert the reciprocating motion of the piston into the rotary motion of the crankshaft.



Two Stroke Petrol Engine

FIRST STROKE:

- Piston moves from TDC to BDC. The spark plug ignites the compressed petrol and air mixture (charge). The hot gases are released during combustion increasing the pressure in the cylinder which forces the piston downwards. The piston moves downwards performing the power stroke until the top of the piston uncovers the exhaust port. The burnt gases escape through the exhaust port. As the piston descends it covers the inlet port and uncovers the transfer port and charge flows from crankcase into the cylinder.
- This charge entering the cylinder drives out the remaining burnt gases through the exhaust port

and the process is called *scavenging.* This process continues till the piston covers both exhaust & transfer port during the next ascending stroke. The crankshaft rotates by half rotation.

SECOND STROKE:

- Piston moves from BDC to TDC. As the piston ascends, it covers the transfer port and the supply of charge to the cylinder is cut-off. Further upward movement covers exhaust port and compression of the charge begins. In the meantime, inlet port opens and fresh charge enters the crankcase. Further

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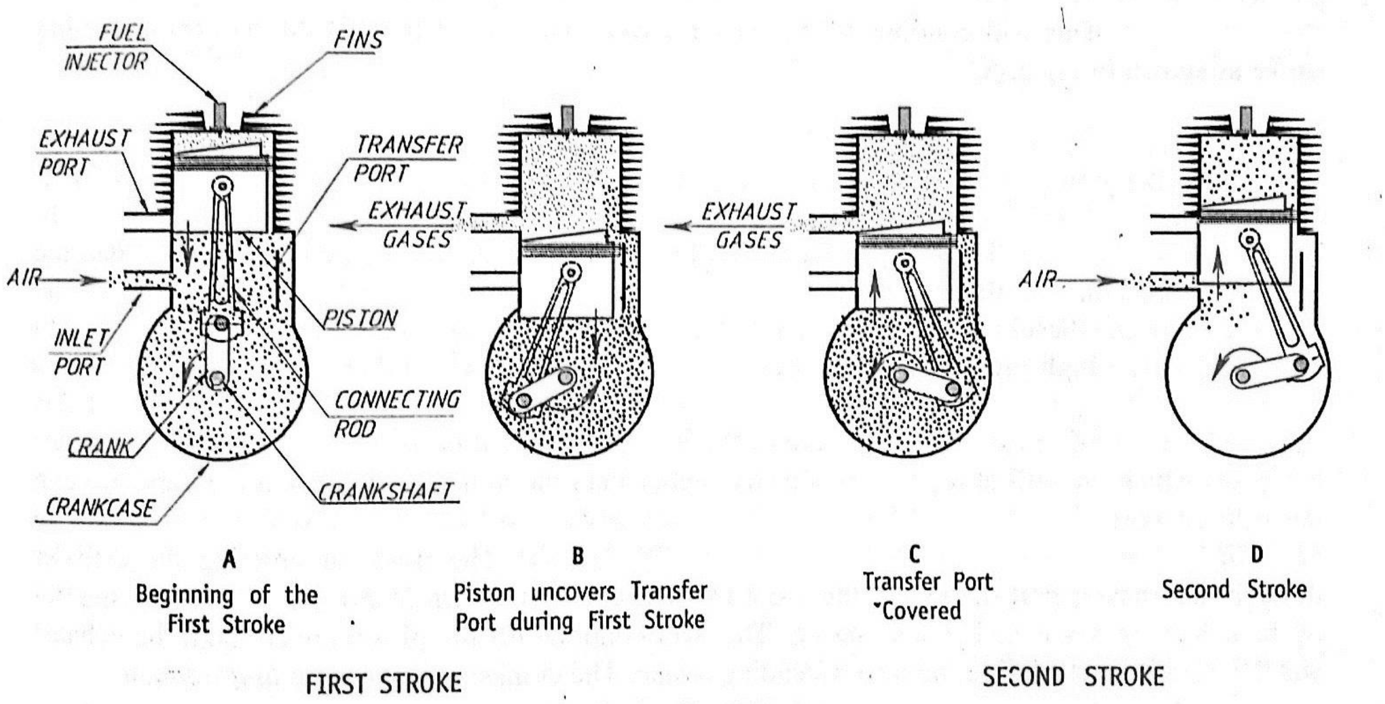
ascend of piston will compress the charge in the cylinder. The compression ratio ranges from 7:1 to 11:1. After piston reaches TDC first stroke repeats again. The crank rotates by half rotation.

2-STROKE DIESEL ENGINE:

- Inlet port – admits fresh air into the crankcase.
- Transfer port – transfers the air from the crankcase into the cylinder.
- Exhaust port – discharges the burnt gases from the cylinder.

These ports are opened and closed by the reciprocating piston. The connecting rod and the crank convert the reciprocating motion of the piston into the rotary motion of the crankshaft.



Two Stroke Diesel Engine

FIRST STROKE:

- Piston moves from cover TDC to BDC. The injector injects a metered quantity of the diesel oil into the cylinder as a fine spray. The high temperature of compressed air ignites the injected diesel oil. The hot gases are released during combustion increasing the pressure in the cylinder which forces the piston downwards. The piston moves downwards performing the power stroke until the top of the piston uncovers the exhaust port. The burnt gases escape through the exhaust port.

- As the piston descends it covers the inlet port and uncovers the transfer port and air flows from crankcase into the cylinder. This air entering the cylinder drives out the remaining burnt gases through the exhaust port and the process is called *scavenging.* This process is continued till the piston covers both exhaust & transfer port during the next ascending stroke. The crankshaft rotates by half rotation.

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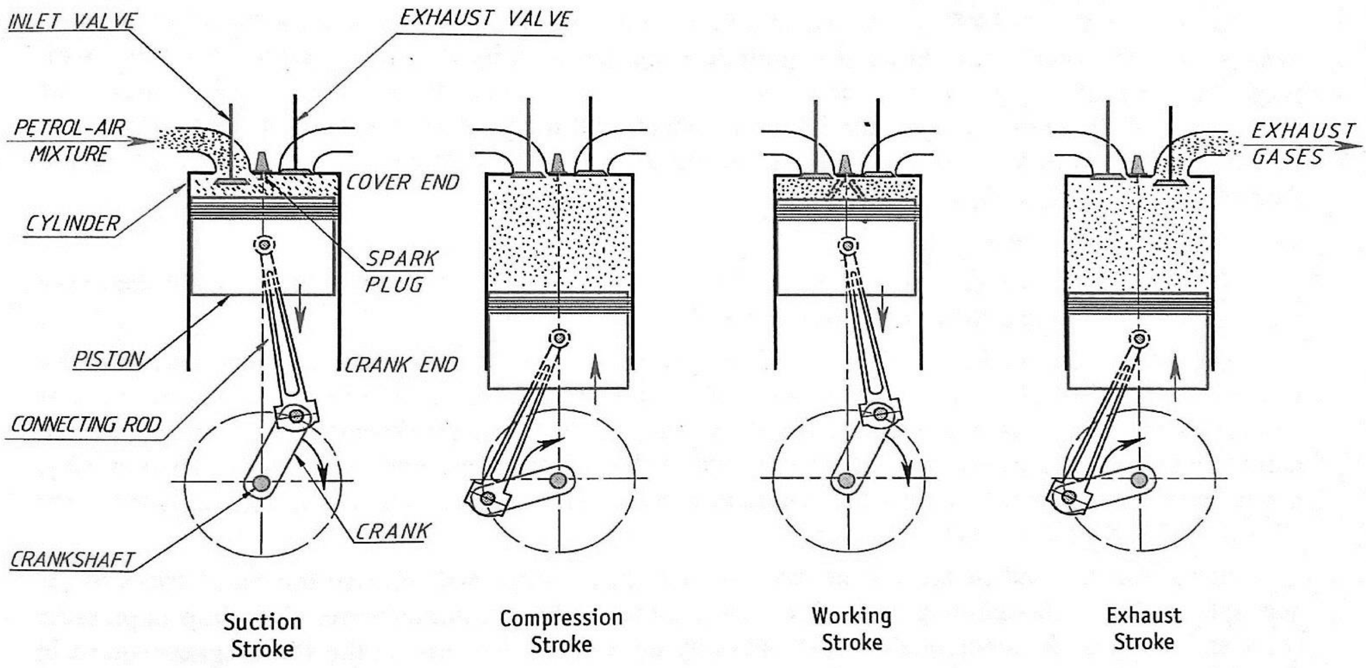
SECOND STROKE:

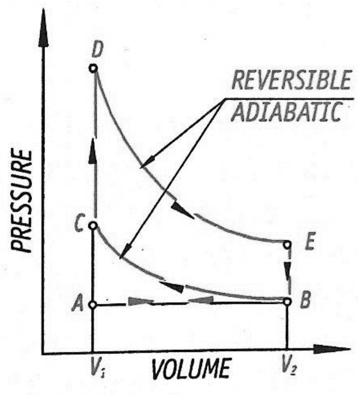
- Piston moves from BDC to cover end TDC. As the piston ascends, it covers the transfer port and the supply of air is cut-off. Further upward movement covers exhaust port and compression of the air begins. In the meantime, inlet port opens and fresh air enters the crankcase. Further ascend of piston will compress the petrol and air mixture in the cylinder. The compression ratio ranges from 20:1 to 22:1. After piston reaches cover end first stroke repeats again. The crank rotates by half rotation.

4-STROKE PETROL ENGINE: (S. I. Engine)

Petrol engines works on the principle of theoretical Otto cycle, also known as **constant volume cycle.** It consists of cylinder, piston, connecting rod, crank, crankshaft, inlet valve, exhaust valve and spark plug. The spark plug fitted at the top of the cylinder initiates the ignition of the petrol, hence the name spark ignition engine.



Four Stroke Petrol Engine



Theoretical Otto Cycle

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ELEMENTS OF MECHANICAL ENGINEERING: MODULE 2

1. SUCTION STROKE:

- During this stroke the piston moves from TDC to BDC. The inlet valve is open and exhaust valve is closed. The crankshaft rotates by half a rotation. As the piston moves downwards, suction is created in the cylinder, as a result, fresh air-petrol mixture is drawn into the cylinder through the inlet valve. At the end of this stroke, the piston is in BDC, the cylinder is filled with air-petrol mixture and inlet valve closes. Horizontal line AB on the P-V diagram.

2. COMPRESSION STROKE:

- During this stroke the piston moves from BDC to TDC. Both the inlet valve and exhaust valves are closed. The crankshaft rotates by half a rotation. As the piston moves upwards, the fuel mixture in the cylinder will be compressed. The ratio of compression ratio in petrol engines ranges from 7:1 to 11:1, represented by the BC curve in the P-V diagram. When the piston reaches TDC, the spark plug ignites the fuel mixture. Since the spark plug ignites the fuel (air-petrol), this type of engine is also called as spark ignition or S.I Engine. The combustion of fuel takes place increasing the pressure at constant volume, represented by the line CD in the P-V diagram.

3. WORKING OR POWER STROKE:

- During this stroke the piston moves from TDC to BDC. Both the inlet valve and exhaust valves are closed. The crankshaft rotates by half a rotation. The high pressure of the burnt gases forces the piston downwards performing power stroke. The linear motion of the piston is converted to rotary motion of the crankshaft by connecting rod and crank. It is represented by curve on DE on PV diagram. At the end of the stroke, the piston is in BDC, the exhaust valve opens which release the burnt gases to the atmosphere. This will bring pressure in the cylinder to atmospheric at constant volume, represented by the line EB in the P-V diagram.

4. EXHAUST STROKE:

- During this stroke the piston moves from BDC to TDC. The inlet valve is closed and exhaust valve is open. The crankshaft rotates by half a rotation. As the piston moves towards the TDC, the burnt gases will be expelled out through the exhaust valve. Line BA on the P-V diagram. When the piston reaches the TDC, the exhaust valve closes and this completes the cycle.

4 STROKE DIESEL ENGINE: (C. I. Engine)

Diesel engines works on the principle of theoretical Diesel cycle, also known as **constant pressure cycle**. It consists of cylinder, piston, connecting rod, crank, crankshaft, inlet valve, and exhaust valve and fuel injector. The fuel injector fitted at the top of the cylinder supplies the measured quantity of diesel at high pressure.

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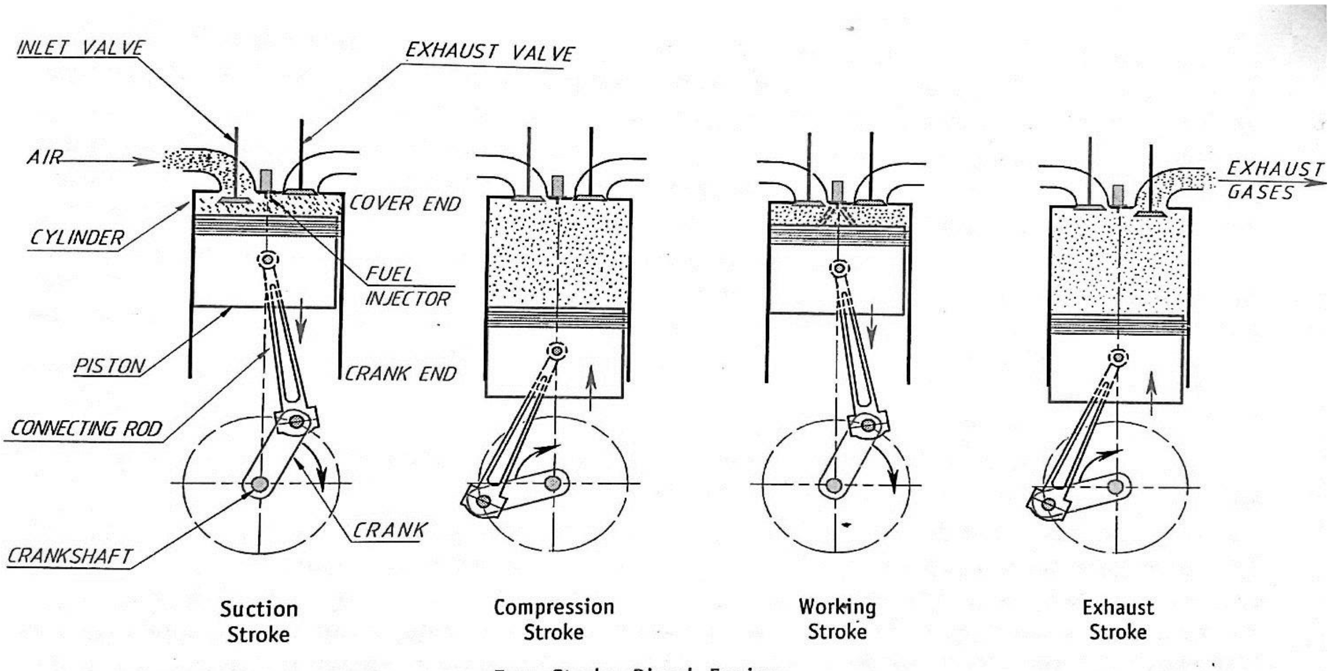
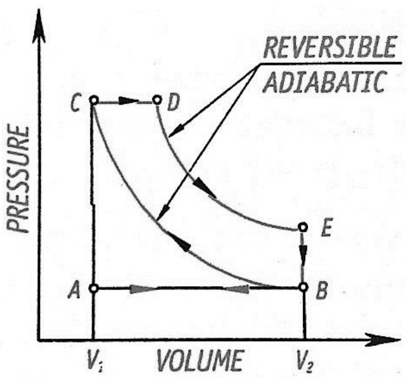
ELEMENTS OF MECHANICAL ENGINEERING: MODULE 2

1. SUCTION STROKE:

- During this stroke the piston moves from TDC to BDC. The inlet valve is open and exhaust valve is closed. The crankshaft rotates by half a rotation. As the piston moves downwards, suction is created in the cylinder, as a result, fresh air is drawn into the cylinder through the inlet valve. At the end of this stroke, the piston is in BDC, the cylinder is filled with air and inlet valve closes. Horizontal line AB on the P-V diagram.



Four–Stroke Diesel Engine



Theoretical Diesel Cycle

2. COMPRESSION STROKE:

- During this stroke the piston moves from BDC to TDC. Both the inlet valve and exhaust valves are closed. The crankshaft rotates by half a rotation. As the piston moves upwards, the air in the cylinder will be compressed. The ratio of compression ratio in diesel engines ranges from 16:1 to 22:1, represented the BC curve in the P-V diagram. As the air gets compressed its pressure and temperature increases and attains a temperature greater than the ignition temperature of diesel. Diesel is sprayed into the cylinder through the fuel injector. The high temperature of the air

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ignites the diesel as soon as it is sprayed and undergoes combustion at constant pressure. Line CD on the P-V diagram. Since the compresses air ignites the diesel, this type of engine is also called as compression ignition or C.I Engine.

3. WORKING OR POWER STROKE:

- During this stroke the piston moves from TDC to BDC. Both the inlet valve and exhaust valves are closed. The crankshaft rotates by half a rotation. The high pressure of the burnt gases forces the piston downwards performing power stroke. The linear motion of the piston is converted to rotary motion of the crankshaft by connecting rod and crank. It is represented by curve DE on PV diagram. At the end of the stroke, the piston is in BDC, the exhaust valve opens which release the burnt gases to the atmosphere. This will bring pressure in the cylinder to atmospheric at constant volume, represented by the line EB in the P-V diagram.

4. EXHAUST STROKE:

- During this stroke the piston moves from BDC to TDC. The inlet valve is closed and exhaust valve is open. The crankshaft rotates by half a rotation. As the piston moves towards the TDC, the burnt gases will be expelled out through the exhaust valve. Line BA on the P-V diagram. When the piston reaches the TDC, the exhaust valve closes and this completes the cycle.

In 4 stroke engine, the 4 strokes constitute one cycle, hence the name 4 stroke cycle engine. The crankshaft makes two revolutions to complete one cycle. The power is developed in every alternate revolution of the crankshaft. 4 Stroke diesel engines produce higher power than 4 Stroke petrol engines.

COMPARISON OF 4 STROKE AND 2 STROKE ENGINE

PRINCIPLE	4 STROKE	2 STROKE
1. Number of strokes per cycle	Four	Two
2. Uses	Cars, trucks, tractors, jeeps, buses, etc.,	Mopeds, scooters, motor cycles, etc.,
3. Power Developed	In every alternate revolution of the crankshaft	In e v e r y revolution of the crankshaft
4. Flywheel	Heavy	Light

5. Admission of charge	Directly to the engine cylinder	First to the crankcase & then transferred to the engine cylinder
6. Exhaust gases	Driven through the outlet during exhaust stroke	Driven out by scavenging operation
7. Valves	Opened & closed by mechanical valves	Opened & closed by piston
8. Noise	Less	High
9.Lubricating oil consumption	Less	More

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10. Fuel consumption	Less	More
11. Mechanical efficiency	Low	High

COMPARISON OF PETROL AND DIESEL ENGINE:

PRINCIPLE	**PETROL**	**DIESEL**
1. Cycle of operation	Otto cycle (constant volume)	Diesel cycle (constant pressure) pressure)
2. Fuel used	Petrol	Diesel
3. Admission of fuel	During suction stroke	At the end of compression stroke.
4. Charge drawn during suction	Air and petrol mixture	Only air
5. Compression ratio	7:1 to 12:1	16:1 to 22:1
6. Type of ignition	Spark ignition	Compression or auto ignition
7. Uses	Scooter, motor cycle, car, etc.,	Trucks, tractors, buses, etc.,
8. Engine speed	High about 7000rpm	Low from 500 to 3000rpm
9. Power output capacity	Less	More
10. Thermal efficiency	Less	High
11. Noise & vibration	Almost nil	High
12. Weight of the engine	Less	High
13. Initial cost	Less	More
14. Operating cost	High	Less
15. Maintenance cost	Less	Slightly higher

16. Starting of the engine	Easily started	Difficult to start in cold weather
17. Exhaust gas pollution	Less	More

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ELEMENTS OF MECHANICAL ENGINEERING: MODULE 2

Performance of IC Engines

1. **Mean effective pressure (MEP):**

The mean effective is defined as mean or average pressure acting on a piston throughout the power stroke. It is also the average pressure developed inside the engine cylinder of an IC engine. It is expressed in Bar. (1 bar = 10^5 N/m^2) pressure of an engine.

The mean effective pressure of an engine is obtained diagram. The indicator diagram is the P –V diagram for one cycle at that load, drawn with the help of an indicator fitted on the engine.

$$P_m = \frac{s * a}{l} \text{ N/ m}^2$$

a = Area of the actual indicator diagram, cm^2

l = Base width of the indicator diagram, cm

s = Spring value of the spring used in the indicator, N/ m^2/cm

2. **Indicated Power:**

Indicated power is defined as the total power developed inside the engine cylinder due to combustion of fuel. It denoted by IP and is expressed in kW.

$$I.P. = \frac{P_m LANk}{60 * 2 * 1000} \quad \text{For 4 Stroke}$$

$$I.P. = \frac{P_m LANk}{60 * 1000} \quad \text{For 2 Stroke}$$

P_m = Mean effective pressure

L= Length of stroke, m

A = Area of cross section of the cylinder, m^2

N = RPM of crankshaft

K = Number of cylinders

3. **Brake Power:**

The net power available at the crank shaft of the engine for performing useful work is called brake power. It is denoted by BP and expressed in kW.

$$B.P. = \frac{2\pi NT}{60 * 1000}$$

T = Torque

4. **Friction power =** Indicated power – Brake power**.**

5. **Mechanical Efficiency:**

It is the efficiency of the moving parts of mechanism transmitting the indicated power to the crankshaft. Therefore, it is *defined as the ratio of the brake power and the indicated power*. It is expressed in percentage.

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$$\eta_{mech} = \frac{\text{Brake Power}}{\text{Indicated Power}} * 100$$

6. Thermal Efficiency:

It is the efficiency of the conversion of the heat energy produced by the actual combustion of the fuel into the power output of the engine. Therefore, it is defined as the ratio of power developed by the engine by the fuel in the same interval of time. It is expressed in percentage.

$$\eta_{Thermal} = \frac{\text{Power Output}}{\text{Heat Supplied}} * 100$$

7. Brake thermal efficiency

Is defined as the ratio of the brake power to the heat supplied by the fuel. It is expressed in percentage.

$$\eta_{BThermal} = \frac{\text{Brake Power}}{CV * m_f} * 100$$

m_f = Mass of the fuel supplied, Kg/s

CV = Calorific Value of the fuel, KJ/Kg

8. Indicated thermal efficiency

Is defined as the ratio of brake power to the heat supplied by the fuel. It is expressed in percentage.

$$\eta_{IThermal} = \frac{\text{Indicated Power}}{CV * m_f} * 100$$

9. Specific fuel consumption:

SFC is defined as the amount of fuel consumed by an engine for one unit of energy that is produced. SFC is used to express the fuel efficiency of an IC engine .it measures the amount of fuel required to provide a given power for a given period. It is expressed in kg/MJ or kg/kW – hr.

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PROBLEMS ON INTERNAL COMBUSTION ENGINES

1) A single cylinder, two stroke IC engine has a piston of diameter 105mm and stroke 120mm. The mean effective pressure is 6Bar. If the crank speed is 1500rpm, calculate the Indicated power of the engine. **Mar1999/July 2005**

2) A gas engine working on four stroke cycle has a cylinder of 250mm diameter, length of stroke 450mm and is running at 180rpm. Its Mechanical efficiency is 80% when the mean effective pressure is 0.65MPa. Find i) Indicated Power. ii)Brake Power
iii) Friction Power **July 2006**

3) A four stroke IC engine running at 450rpm has a bore diameter of 100mm and stroke length of 120mm. The indicator diagram details are: area of the diagram $4cm^2$, length of indicator 6.5cm and the spring value of the spring used is 10Bar/cm. Calculate the Indicated Power of the engine.
Aug 1999

4) The following observations were recorded during a test on four stroke diesel engine: Bore=200mm, Stroke=250mm, Mean Effective Pressure=0.6MPa, Brake Drum diameter=1.2mm, Net Brake load=500N, Speed of Crank Shaft=600rpm.
Find i) Indicated Power ii) Brake Power iii) Friction Power iv) Mechanical Efficiency

July 2011

5) A two stroke diesel engine has a piston diameter of 200mm and a stroke length of 300mm. The engine has a mean effective pressure of 3.6Bar and a speed of 400rpm. The effective diameter of brake drum is 1m and the load on this is 81kg. Determine Indicated Power, Brake Power and Mechanical Efficiency. **July 2007**

6) A single cylinder 4 stroke engine runs at 1000rpm and has a bore of 115mm and has a stroke of 140mm. The brake load is 6kg at 600mm radius and the mechanical efficiency is 80%. Calculate Brake Power and Mean Effective Pressure. **July 2004**

7) Following data are collected from a four stroke single cylinder oil engine at full load. Bore=200mm, Stroke=280mm, Speed=300rpm, Indicated mean effective pressure=5.6Bar, Torque on the brake drum=250N-m, Oil consumed=4.2kg/hour, Calorific value of oil=41000KJ/kg. Determine Mechanical Efficiency, Indicated Thermal Efficiency & Brake Thermal Efficiency.
Jan 2010

8) A single cylinder four stroke IC engine has a bore of 180mm, stroke of 200mm and a rated speed of 300rpm. Torque on the brake drum is 200N-m and mean effective pressure is 6Bar. It consumes 4kg of fuel in 1 hour. The calorific value of the fuel is 4200KJ/kg. Determine i) Brake power ii) Indicated power iii) Brake thermal efficiency iv) Mechanical efficiency **July 2003**

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9) A four stroke diesel engine has a piston diameter 250mm & stroke 400mm. The mean effective pressure is 4Bar and the speed is 500rpm. The diameter of the brake drum is 1m and the effective brake load is 400N. Find Indicated power, Brake power and Friction power. **June 2010**

10) A four stroke petrol engine of 100mm bore and 150mm stroke consumes 1kg of fuel per hour. The mean effective pressure is 7Bar and its indicated thermal efficiency is 30%. The calorific value of the fuel is 40000KJ/kg. Find the Crankshaft speed. **Sept. 2006**

11) Calculate the brake power of a single cylinder four stroke petrol engine which is running at a speed of 400rpm. The load on the brake drum is 24kg and the spring balance reads 4kg. The diameter of the brake drum is 600mm and the rope diameter is 30mm. **Jan 2007**

12) A single cylinder four stroke IC engine has a volume of 6 litres and runs at 300rpm. At full load, the tension in the tight side and slack side of the dynamometer belt is 700N and 300N respectively. The pulley diameter of dynamometer is 1m. The fuel consumed in one hour is 4kg with a calorific value of 42000KJ/kg. If the indicated mean effective pressure is 6Bar, Calculate the Indicated power, Brake power, Mechanical efficiency, Indicated thermal efficiency, brake thermal efficiency and specific fuel consumption on brake power basis. **June 2009**

13) A four cylinder two stroke petrol engine develops 30KW at 2500rpm. The mean effective pressure on each piston is 6Bar and mechanical efficiency is 80%. Calculate the diameter and stroke of each cylinder if the stroke to bore ratio is 1.5. Also calculate the fuel consumption, if the brake thermal efficiency is 28%. The calorific value of the fuel is 43900KJ/kg. **Feb 2005/Jan 2013**

14) A person conducted a test on a single cylinder two stroke petrol engine and found that the mechanical and brake thermal efficiencies of the engine were 0.7 and 0.2 respectively. The engine with a mean effective pressure of 6Bar runs at 300rpm consuming fuel at a rate of 2.2kg/hr. Given that the calorific value of the fuel as 42500KJ/kg and that the stroke to bore ratio of the engine cylinder is 1.2. Find the bore and stroke of the engine. **Jan 2006**

15) A single cylinder four stroke diesel engine develops indicated power of 30KW at 3000rpm. The indicated mean effective pressure is 6.5Bar, and the piston speed is limited to 180m/min. Determine the stroke and diameter of the cylinder. Also find the specific fuel consumption on brake power basis, if the mechanical efficiency is 80% and the indicated thermal efficiency is 30%. Take the calorific value of diesel as 40MJ/kg. **Jan 2008**

16) The following observations were recorded during a test on a four stroke engine. Bore=250mm, Stroke=400mm, Crank speed=250rpm, net load on Brake drum=700N, Diameter of the Brake drum=2m, Indicated mean effective pressure=6Bar, Fuel consumption=0.0013kg/s, Specific quantity of fuel=0.78, Calorific value of fuel=43900KJ/kg. Determine i) Brake power ii) Indicated power iii) Friction power iv) Mechanical efficiency v) Indicated & Brake thermal efficiency.

Jan 2009/2011

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17) The following are the details of a four stroke petrol engine: (i) Diameter of Brake drum=600.3mm

(ii) Full brake load on drum=250N (iii) Brake drum speed=450rpm (iv) Calorific value of petrol=40MJ/kg (v) Brake thermal efficiency=32%
(vi) Mechanical efficiency=80% (vii) Specific gravity of petrol=0.82.

Determine a) Brake power b) Indicated power c) Fuel consumption in litres per second d) Indicated thermal efficiency. **Jan 2004**

18) A gas engine working on a four stroke cycle has a cylinder diameter 0.25m and length of stroke 0.45m and is running at 180rpm. Its mechanical efficiency is 80% when the mean effective pressure is 6.5Bars. Find Indicated power, Brake power and Friction power. What is the fuel consumption rate (kg/hr) and brake specific fuel consumption (kg/KWhr) if the energy content of the fuel used is 42000KJ/kg and brake thermal efficiency is25%? **June 2008**

19) A six cylinder, four stroke IC engine develops 50KW of indicated power at mean effective pressure of 700KPa. The bore and stroke length are 70mm and 100mm respectively. If the engine speed is 3700rpm, find the average misfires per unit time. **July 2013**

SOLUTIONS

Mean Effective Pressure (MEP) - Pm

Average pressure developed inside the engine cylinder.

Indicator diagram is the P-V diagram for 1 cycle at that load, drawn with the help of an indicator fitted on the engine.

$$Pm = \frac{s * a}{l}$$

a = Area of actual indicator diagram in m^2
l = Base width of indicator diagram in m
s = Spring value of the spring used in the indicator in Bar/m

$$1 \text{ Bar} = 10^5 \text{ Pa} = 10^5 \text{ N/m}^2 \text{ or } 1\text{Pa} = 1 \text{ N/m}^2$$

Indicated Power – I.P.

In 4-Stroke 1 cycle will be completed in 2 revolutions of the crankshaft.

Number of cycles per minute = Half the number of rpm n = N/2 for 4 stroke

n = N for 2 stroke

For 4 stroke I.P. = $\frac{PmLANk}{60*2*1000}$ KW (Pm is in N/m^2)

I.P. = $\frac{PmLANk}{60*2}$ KW (Pm is in Bar)

For 2 Stroke I.P. = $\frac{PmLANk}{60*1000}$ KW (Pm is in N/m^2)

L = Length of the stoke in m

A = C/S area of the cylinder = $\pi/4 D^2$ in m^2

D = Diameter of the cylinder = Bore Diameter in m

N = RPM of the crankshaft

k = Number of cylinders

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$$I.P. = \frac{P_m L A N k}{60} \text{ KW } (P_m \text{ is in Bar})$$

Brake Power – B.P.

$$B.P. = \frac{2\pi NT}{60 * 1000} \text{ KW}$$

T = W*R in N-m

W = Weight in Kg   1Kg = 9.81N

T = 9.81 W*R   R = Radius of Brake drum

T = Torque applied due to net load W, on the Brake drum

Torque (T) is measured by using

i. **Belt Dynamometer**

Torque = Force*Distance

$T = (T_1 - T_2) * R$ N-m

T_1 = Tension in tight side of the belt (N)

T_2 = Tension in slack side of the belt (N)

R = Radius of pulley (m)

ii. **Rope Brake Dynamometer**

T = (W-S) *R   N-m

$$R = \frac{D_{DRUM} + d_{ROPE}}{2} \text{ (m)}$$

Friction Power – F.P.

F.P. = I.P. – B.P.   (KW)

Mechanical Efficiency – η_{mech}

$$\eta_{mech} = \frac{B.P.}{I.P.} * 100$$

Thermal Efficiency - □□□

$$\eta_{th} = \frac{\text{Power Output}}{\text{Heat Supplied}} * 100$$

Heat Supplied = m_f * CV

m_f = mass of fuel in Kg/s

CV = Calorific value of fuel in KJ/Kg

i. **Indicated Thermal Efficiency** □□□□

$$\eta_{ith} = \frac{I.P.}{m_f * CV}$$

ii. **Brake Thermal Efficiency** □□□□

$$\eta_{bth} = \frac{B.P.}{m_f * CV}$$

Specific Fuel Consumption – Sfc

Describes the fuel efficiency of an engine design

$$Sfc = \frac{m_f(\frac{Kg}{hr})}{\text{Power Developed (KW)}} (Kg/KW\text{-}hr)$$

$$isfc = \frac{m_f}{I.P.} (Kg/KW\text{-}hr)$$

$$bsfc = \frac{m_f}{B.P.} (Kg/KW\text{-}hr)$$

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Problem 1

Given: k=1, 2 stroke n=N

D=105mm =0.105m

L=120mm = 0.12m

Pm= 6Bar =$6*10^5$ N/m^2

N= 1500 rpm

$$I.P. = \frac{PmLANk}{60*1000} KW$$

$$I.P. = \frac{6*10^5*0.12*8.6*10^{-3}*1500}{60*1000} KW$$

I.P. = 15.58 KW

$A = \frac{\pi}{4}D^2$

$A = \frac{\pi}{4} * 0.105^2$

$A = 8.6*10^{-3}\ m^2$

Problem 2

Given: k=1, 4 stroke

D=250mm =0.25m

L=450mm = 0.45m

Pm= 0.65MPa = $6.5*10^5$ N/m^2

N= 180 rpm

η_{mech} = 80%

$A = \frac{\pi}{4}D^2$

$A = \frac{\pi}{4} * 0.25^2$

$A = 4.9*10^{-2}\ m^2$

$$I.P. = \frac{PmLANk}{60*2*1000} KW$$

$$I.P. = \frac{6.5*10^5*0.45*4.9*10^{-2}*180*1}{60*2*1000} KW$$

I.P. = 21.53 KW

$\eta_{mech} = \frac{B.P.}{I.P.}*100$

B.P.= 0.8*I.P.

B.P.= 17.22KW

F.P.= I.P.-B.P. = 21.53-17.22 = 4.31KW

Problem 3

$P_m = \frac{s*a}{} = \frac{10*4}{} = 6.15$ Bar = $6.15*10^5$ N/m^2

$A = \frac{\pi}{}D^2$

Given: k=1, 4 stroke

D=100mm =0.1m

L=120mm = 0.12m

a = 4cm^2

l = 6.5cm

s = 10Bar/cm

$\overline{l}$ ~~6.5~~ 4

$$I.P. = \frac{PmLANk}{60 * 2 * 1000} KW$$

$$A = \frac{\pi}{4} * 0.1^2$$

$$A = 7.85*10^{-3}\ m^2$$

$$I.P. = \frac{6.15 * 10^5 * 0.12 * 7.85 * 10^{-3} * 450 * 1}{60 * 2 * 1000} KW$$

Problem 4

I.P. = 2.17 KW

F.P. = I.P. – B.P. = 4.7KW

Given: k=1, 4 stroke

I.P = 23.57KW

D=200mm =0.2m

L=250mm = 0.25m

W= 500N

N = 600rpm

DDRUM = 1.2m

Pm = 0.6MPa = 6*10^5 N/m^2

$$B.P. = \frac{2\pi NT}{60 * 1000} KW$$

T = W*R = 500*0.6 = 300 N-m

B.P. = 18.85KW

$$\eta_{mech} = \frac{B.P.}{I.P.} *100$$

η_{mech} = 80%

Problem 5

Given: k=1, 2 stroke

D= 0.2m

L= 0.3m

W= 81Kg = 81*9.81 = 794.61N

N = 400rpm

DDRUM = 1m

$$I.P. = \frac{PmLANk}{60 * 1000} KW$$

I.P. = 22.62 KW

$$B.P. = \frac{2\pi NT}{60 * 1000} KW \quad T=W*R$$

B.P. = 16.64

KW

η_{mech}=

73.5%

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ELEMENTS OF MECHANICAL ENGINEERING: MODULE 3

R = 0.5m

Pm = 3.6Bar = $3.6*10^5$ N/m^2

Problem 6

Given: k=1, 4 stroke

D= 115mm= 0.115m

L= 140mm= 0.14m

W= 6Kg = 6*9.81 = 58.86N

N = 1000rpm

R = 600mm= 0.6m

$\eta_{mech} = 0.8$

$$B.P. = \frac{2\pi NT}{60*1000} \text{ KW} \quad T=W*R$$

B.P. = 3.7 KW

$$\eta_{mech} = \frac{B.P.}{I.P.} *100 \Rightarrow I.P.= 4.62KW$$

$$I.P. = \frac{PmLANk}{60*2*1000} \text{ KW} \Rightarrow Pm = \frac{I.P.*60*2*1000}{LANk} = 3.96*10^5 \text{ N/m}^2$$

Problem 7

Given: k=1, 4 stroke

D= 200mm= 0.2m

L= 280mm= 0.28m

N = 300rpm

Pm = 5.6Bar = $5.6*10^5$ N/m^2 T= 250N-m

mf = 4.2Kg/hr = $1.167*10^{-3}$Kg/s CV = 41000KJ/Kg

I.P.= 12.3KW

B.P. = 7.85KW

$\eta_{mech} = 63.9\%$

$$\eta_{ith} = \frac{I.P.}{mf*CV} = \frac{12.3}{1.167*10^{-3}*41000} = 25.7\%$$

$$\frac{B.P.}{} \quad \frac{7.85}{}$$

$\eta_{bth} = \frac{}{m_f * CV} = \frac{1.167*10^{-3} * 41000}{} = 16.4\%$

Problem 8

Given: k=1, 4 stroke

D= 180mm= 0.18m

L= 200mm= 0.2m

N = 300rpm

$P_m = 6*10^5$ N/m^2 T= 200N-m

m_f = 4Kg/hr = $1.11*10^{-3}$Kg/s CV = 42000KJ/Kg

$$B.P. = \frac{2\pi NT}{60*1000} KW = 6.28KW$$

$$I.P. = \frac{P_mLANk}{60*2*1000} KW = 7.63KW$$

$$\eta_{bth} = \frac{B.P.}{m_f * CV} = 13.5\%$$

$$\eta_{mech} = \frac{B.P.}{I.P.} *100 = 82.3\%$$

Problem 9

Given: k=1, 4 stroke

D= 250mm= 0.25m

L= 400mm= 0.4m

N = 500rpm

P_m = 4Bar = $6*10^5$ N/m^2 D_b = 1m, R_b = 0.5m

W= 400N

$$I.P. = \frac{P_mLANk}{60*2*1000} KW = 32.73KW$$

$$B.P. = \frac{2\pi NT}{60*1000} KW \quad T= W*R$$

B.P. = 10.47KW

F.P. = I.P.- B.P. = 22.25KW

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ELEMENTS OF MECHANICAL ENGINEERING: MODULE 3

Problem 10

Given: k=1, 4 stroke

D= 100mm= 0.1m

L= 150mm= 0.15m

P_m = 7Bar = $7*10^5$ N/m^2

m_f = 1Kg/hr = $2.77*10^{-4}$ Kg/s CV = 40000KJ/Kg

η_{ith}= 30%

$$\eta_{ith} = \frac{I.P.}{m_f * CV} \Rightarrow I.P. = \frac{m_f * CV}{\eta_{ith}}$$

$$I.P. = \frac{PmLANk}{60*2*1000} KW \Rightarrow N = \frac{I.P*60*2*1000}{PmLAk}$$

N = 483.7rpm

Problem 11

Given: k=1, 4 stroke

W= 24Kg

S= 4Kg

L= 400mm= 0.4m

N = 400rpm

D_b = 600mm, R_b = 300mm D_R = 30mm, R_R = 15mm

$$B.P. = \frac{2\pi NT}{60*1000} KW$$

T = (W-S) *R N-m = (24-4) *9.81*315*10^{-3}

T = 61.8 N-m

B.P. = 2.59KW

Problem 12

Given: k=1, 4 stroke

Volume = 6litres

A*L = 6000cm^3= $6*10^{-3}$m^3

$$I.P. = \frac{PmLANk}{60*2*1000} KW = 9KW$$

$$\eta_{ith} = \frac{I.P.}{m_f * CV} = 19.28\%$$

$$B.P. = \frac{2\pi NT}{60*1000} KW$$

η = B.P.

$= 13.46\%$

N= 300rpm

$T_1 = 700N$, $T_2 = 300N$

$D_p = 1m$, $R_p = 0.5m$

$P_m = 6*10^5\ N/m^2$

$m_f = 4Kg/hr = 1.11*10^{-3} Kg/s$ CV = 42000KJ/Kg

$T = (T_1 - T_2) * R$ N-m = 200N-m

B.P. = 6.283KW

$\eta_{mech} = 69.8\%$

$\eta_{bth} = \frac{B.P.}{m_f * CV}$

$bsfc = \frac{m_f}{B.P.}$ (m_f in kg/hr)

bsfc = 0.6366 Kg/KW-hr

Problem 13

Given: k= 4, 2 stroke

B.P.= 30KW

N=2500rpm

$P_m = 6*10^5\ N/m^2$

$\eta_{mech} = 0.8$

$\frac{L}{D} = 1.5$, L=1.5D

$\eta_{bth} = 28\%$

CV= 43900KJ/Kg

$\eta_{mech} = \frac{B.P.}{I.P.} *100 \Longrightarrow$ I.P.= 37.5KW

$I.P. = \frac{PmLANk}{60 * 1000}$ KW

$$37.5 = \frac{6 * 10^5 * 1.5D * \pi * D^2 * 2500 * 4}{60 * 1000 * 4} KW$$

$$D^3 = \frac{37.5 * 60000}{6 * 10^5 * 1.5 * \pi * 2500} KW$$

D= 0.068m or 68mm,

L=1.5D= 102mm or 0.102m

$\eta_{bth} = \frac{B.P.}{m_f * CV} \Longrightarrow m_f = \frac{B.P.}{\eta_{bth} * CV}$

$m_f = 2.44*10^{-3}Kg/s = 8.78Kg/hr$

$bsfc = \frac{m_f}{B.P.}$ (m_f in kg/hr)

bsfc = 0.2926 Kg/KW-hr

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ELEMENTS OF MECHANICAL ENGINEERING: MODULE 3

Problem 14

Given: k= 1, 2 stroke

η_{mech}= 0.7

$\frac{L}{D}$ = 1.2, L=1.2D

η_{bth}= 0.2

CV= 42500KJ/Kg

N=300rpm

Pm = 6Bar = 6*10^5 N/m^2

mf = 2.2Kg/hr = 6.11*10^{-4}Kg/s

$\eta_{bth} = \frac{B.P.}{m_f * CV}$ ⇒ B.P. = 5.19KW

$\eta_{mech} = \frac{B.P.}{I.P.}$ *100 ⇒ I.P.= 7.42KW

I.P. = $\frac{PmLANk}{60 * 1000}$ KW

D = 137mm or 0.137m

L = 1.2D = 1.2*137=164mm or 0.164m

Problem 15

Given: k= 1, 4 stroke

η_{mech} = 0.7

I.P.= 30KW

η_{ith} = 30%

CV= 40MJ= 40000KJ/Kg

N=3000rpm

Velocity of the Piston

V = 2LN

3=2L* $\frac{3000}{60}$

OR

h

180=2*l*3000=0.03m

PmLANk

$\eta_{mech} = \frac{\eta_{bth}}{\eta_{ith}} = \frac{B.P.}{I.P.}$

η_{bth}= 0.24 B.P.= 24KW

$\eta_{bth} = \frac{B.P.}{m_f * CV}$

mf = 2.5*10^{-3}Kg/s or 9Kg/hr

mf

$P_m = 6.5*10^5\ N/m^2$

Velocity of Piston = 2LN

=180m/min

I.P. = ——— KW

60* 2* 1000

D= 0.28m

bsfc = (mf in kg/hr)

B.P.

bsfc = 0.375 Kg/KW-hr

Problem 16

Given: k=1, 4 stroke

D= 250mm= 0.25m

L= 400mm= 0.4m

W=700N

N = 250rpm

D= 2m

P_{im}=

6Bar

mf=

0.0013Kg/s

s.g.= 0.78

CV= 43900KJ/Kg

B.P.= 18.32KW

I.P.= 25.54KW

F.P.= 6.218KW

η_{mech} = 74.7%

η_{ith} = 43%

η_{bth} = 32.1%

Problem 17

Given: k=1, 4 stroke

N = 450rpm

D_b = 600.3mm, R_b =

300.15mm W= 250N

CV=40MJ/Kg

η_{bth} = 32%

η_{mech} = 80%

S.G.= 0.82

Exercise Problem

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ELEMENTS OF MECHANICAL ENGINEERING: MODULE 3

Problem 18

Given: k=1, 4 stroke

D= 0.25m

L= 45m

N= 180rpm

Pm = 6.5Bar = 6.5*10^5

N/m^2 CV = 42000KJ/Kg

η_{bth}= 25%

η_{mech}= 80%

I.P.= 21.54KW

B.P.= 17.2KW

F.P.= 4.3KW

mf = 1.969Kg/hr = 5.469*10^{-4}Kg/s bsfc= 0.3428Kg/KW-hr

Problem 19

Given: k=6, 4 stroke

Pm = 700*10^3 Pa = 7*10^5

N/m^2 D= 0.07m

L= 0.1m

N'=3700rpm

I.P.= 50KW

$$I.P. = \frac{PmLANk}{60 * 2 * 1000} KW$$

Theoretical Speed N= 3712rpm

For 4 stroke engine $\frac{N}{2} = \frac{3712}{2}$ = 1856rpm

Actual explosions per minute = $\frac{N'}{2} = \frac{3700}{2}$ = 1850rpm

Therefore, number of misfires = 1856-1850 = 6

REFRIGERATION AND AIRCONDITIONING

Refrigeration: It is defined as a method of reducing temperature of a system below that of the surroundings and maintaining it at the lower temperature by continuously abstracting the heat from it.

Refrigerant: The medium or working substance that continuously extracts heat from the space within the refrigerator which is to be kept cool at temperature less than atmospheric by rejecting heat to atmosphere is called refrigerant.

Refrigeration concepts:

1. Heat flows from a system at higher temperature to a system at lower temperature.
2. Fluids absorb heat, change from liquid phase to vapor phase and condenses back to liquid while by giving off heat.
3. The boiling and freezing temperatures of fluid depends on its pressure.
4. Heat can flow from a system at lower temperature to a system at higher temperature only with the aid of external work.

Refrigerating effect: The rate at which the heat is absorbed in a cycle from the interior space to be cooled is called refrigerating effect.

Unit of refrigeration: The capacity of refrigeration system is expressed in **tons of refrigeration**.

A ton of refrigeration is defined as the quantity of heat absorbed in order to form one ton of ice in 24hours from water at 0^0C.

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In S.I System

1 ton of refrigeration = 210 kJ/min

= 3.5 Kw

Coefficient of performance: The coefficient of performance (COP) of a refrigeration system is defined as the ratio of the refrigerating effect (heat absorbed or removed) to the work supplied.

If Q = Heat absorbed or Removed, kW

W = Work supplied, kW

Then, COP = Q/W

Ice making capacity

The capacity of a Refrigerating system to make ice beginning from water (at water temperature) to solid ice. It is usually specified by kg/hr.

Relative COP

It is defined as the ratio of Actual COP to the Theoretical COP of a refrigerator.

Relative COP = Actual COP/Theoretical COP

Refrigerants commonly used:

1. Ammonia – in vapor absorption refrigerator.
2. Carbon dioxide – in marine refrigerators.
3. Sulphur dioxide – in household refrigerators.
4. Methyl chloride – in small scale & domestic refrigerators.
5. Freon – 12 (**Dichlorodifluoromethane**) – in domestic vapor compression refrigerators.
6. Freon – 22 (**difluoromonochloromethane**) – in air conditioners.

Properties of a good refrigerant:

- Must have low boiling point.
- Must have low freezing point.
- Evaporator & condenser pressure should be slightly above the atmospheric pressure.
- Latent heat of evaporation must be very high.
- Specific volume must be very low.
- Toxicity - should be non-toxic.
- Flammability - should not be flammable.
- Corrosiveness - should be non-corrosive.
- COP must be high.
- Odour - must be odourless.
- Leakage should be easily detectable.

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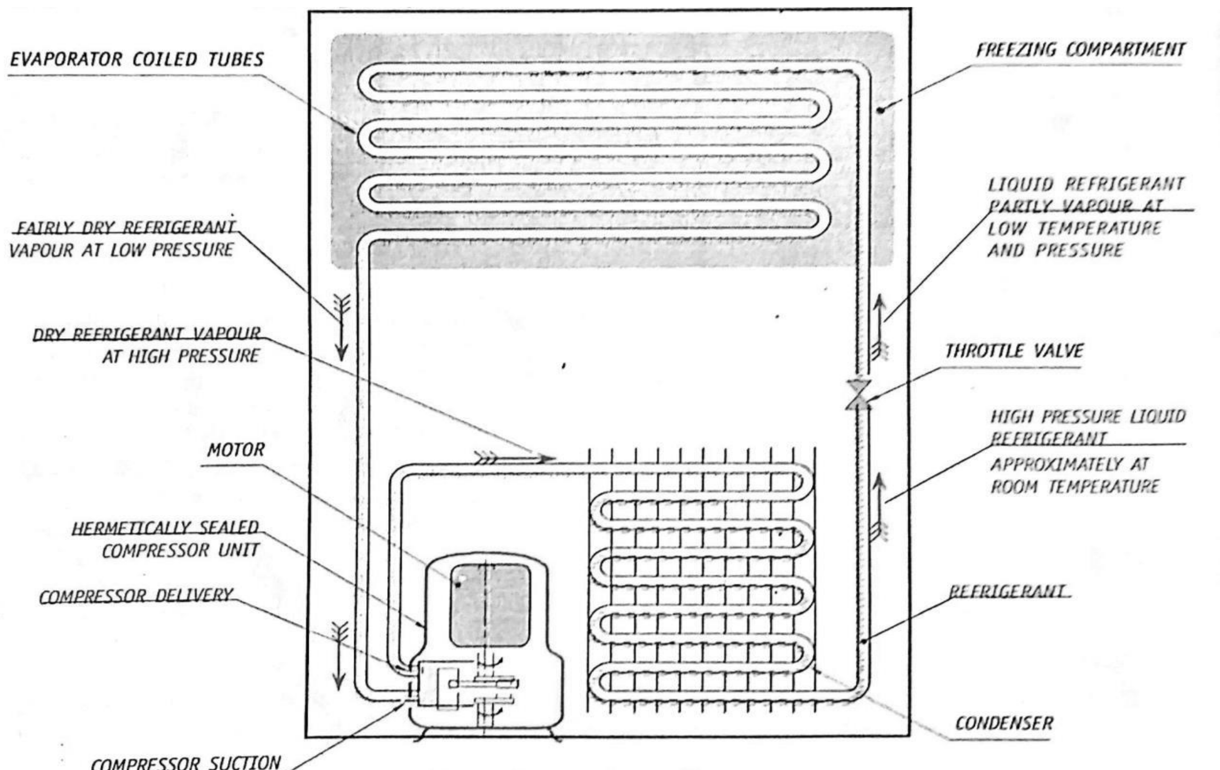
VAPOUR COMPRESSION REFRIGERATOR

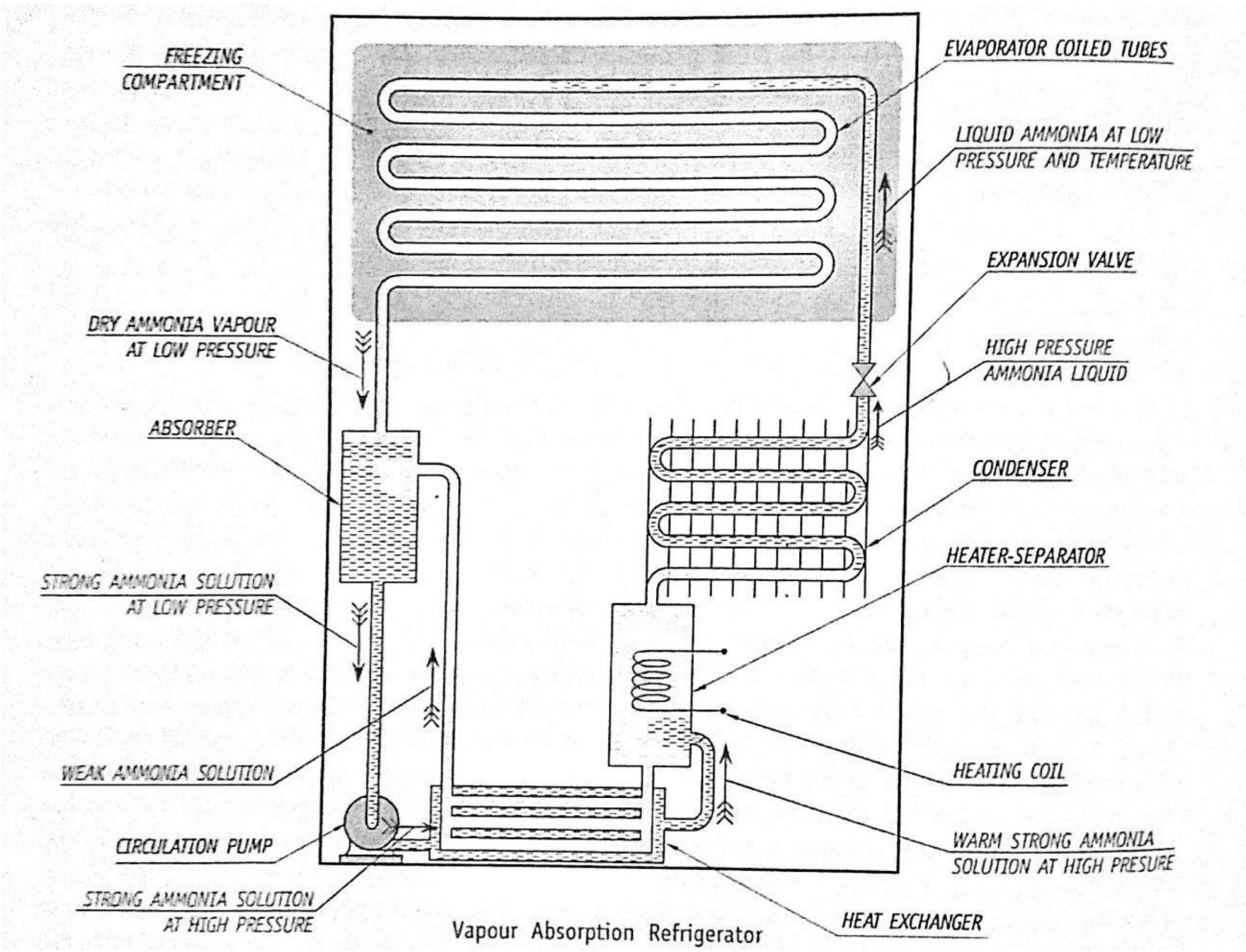


Vapour Compression Refrigerator

- It mainly consists of a compressor, a throttle valve, a condenser and an evaporator made of coiled tubes installed in the freezing compartment of the refrigerator.
- The refrigerant at low pressure and temperature passing in the evaporator coiled tubes absorbs heat from the contents in the freezing compartment and evaporates.
- This lowers the temperature of freezing compartment.
- The vapour refrigerant at low pressure from evaporator is drawn by the compressor which compresses it to high pressure.
- This increase in pressure increases the saturation temperature of the refrigerant higher than the temperature of the cooling medium (atmospheric air) in the condenser so that vapour can reject heat in the condenser.
- In the condenser it gives off its latent heat to the atmosphere air and condenses to liquid.
- The high pressure liquid refrigerant now flows to the throttle valve in which it expands to a low pressure.
- Temperature reduces to -10°C and vapour will be wet.

- This wet vapour now passes to the evaporator coils where it absorbs heat from the surrounding and the cycle repeats.
- Thus heat is continuously removed from the contents of the refrigerator in the evaporator and rejected in the condenser to the atmospheric air.
- This will keep the contents of the refrigerator at lower temperature.
- The most commonly used refrigerant in vapour compression refrigerator is dichlorodifluoromethane popularly known as Freon 12.

VAPOR ABSORPTION REFRIGERATION SYSTEM



Vapour Absorption Refrigerator

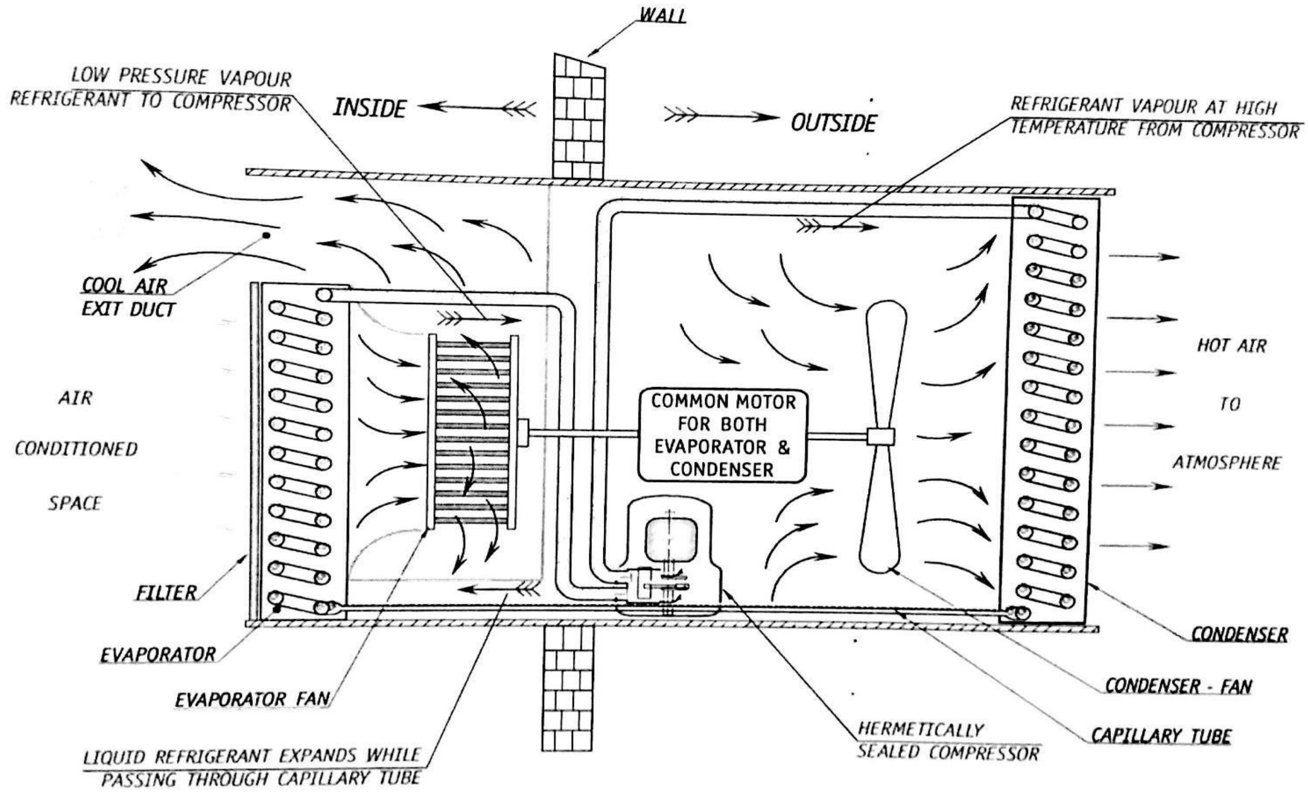
- This refrigerator mainly consists of an absorber, a circulating pump, heat exchanger, generator, condenser, expansion valve and evaporating coiled tubes.
- Low pressure ammonia vapor is dissolved in the cold water contained in the absorber, which will produce a strong ammonia solution.
- The strong ammonia solution from absorber is pumped to heat exchanger where it is warmed by the

warm weak ammonia solution flowing back from the heat separator.

- The warm high pressure ammonia solution now passes to the heat separator where it is heated by heating coils.
- The heating will drive out the ammonia vapor from it. Now the solution in heat separator becomes weak and flows back to the heat exchanger where it warms up the strong ammonia solution passing through it.
- The high pressure ammonia vapor from heat separator now passes to a condenser, where it rejects heat and is condensed. (liquid)
- The high pressure ammonia liquid is now expanded to low pressure and low temperature in the throttle valve.
- The low pressure condensed ammonia liquid at low temperature is passed onto the evaporator coils provided in the freezing compartment, where it absorbs the heat and evaporates.
- The low pressure ammonia vapor from freezing compartment is passed again to the absorber and the cycle repeats.

- **Comparison Between Vapor Compression and Vapor Absorption Systems**
-

• **Principle**	• **Vapor compression**	• **Vapor absorption**
• **Working method**	• Refrigerant vapor is compressed	• Refrigerant vapor is absorbed and • Heated
• **Type of energy** • **supplied**	• Mechanical	• Heat
• **Work or energy** • **supplied**	• To compress refrigerant	• To run the pump
• **COP**	• Higher	• Relatively low & remains same
• **Capacity**	• Up to 1000 tons	• Above 1000 tons
• **Noise**	• More	• Almost quiet
• **Refrigerant**	• Freon-12	• Ammonia
• **Leakage problem**	• Chances are more	• No leakage
• **Maintenance**	• High	• Less
• **Operating cost**	• High	• Less



Air Conditioner

AIR CONDITIONING:

Providing a cool congenial indoor atmosphere by cooling, humidifying, or dehumidifying, cleaning and recirculating the surrounding air is called air conditioning. The artificial cooling of air and conditioning it to provide maximum comfort to human beings is called comfort air conditioning.

The artificial cooling of air and conditioning it to provide a controlled atmosphere required in some engineering, manufacturing and processing is called industrial air conditioning.

ROOM AIR CONDITIONER AND PRINCIPLES OF AIR CONDITIONING:

An air conditioner continuously draws air from an indoor space to be cooled, cools it by the refrigeration principles and discharges back into the same indoor space that needs to be cooled.

It mainly consists of an evaporator, condenser, compressor, two fans one each for evaporator and condenser units usually driven by the single motor, capillary, etc. It is generally mounted on a window sill such that the evaporator unit is inside the room and the condenser part projecting outside the building.

- The high pressure, high temperature liquid refrigerant from the condenser is passed to the evaporator coils through the capillary tube where it undergoes expansion.
- The refrigerant in evaporator coils absorbs heat from the air passing over it from the interior and evaporates.
- The high temperature evaporated refrigerant is compressed to high pressure by a compressor and delivered to the condenser, where it is cooled or condensed to liquid by giving off the heat to the atmospheric air passing over it.
- The cooled high pressure refrigerant now passes through the capillary tube where it undergoes expansion and again re-circulated to repeat the cycle continuously.

ABSOLUTE HUMIDITY: It is defined as ratio of water vapour contained in a given volume of air.

SPECIFIC HUMIDITY: It is defined as the ratio of weight of water vapour to the total weight of air.

RELATIVE HUMIDITY: It is defined as the ratio of the actual vapour content of the air to the vapour content of the air at the same temperature when saturated with water vapour

MODULE 3

INTRODUCTION:

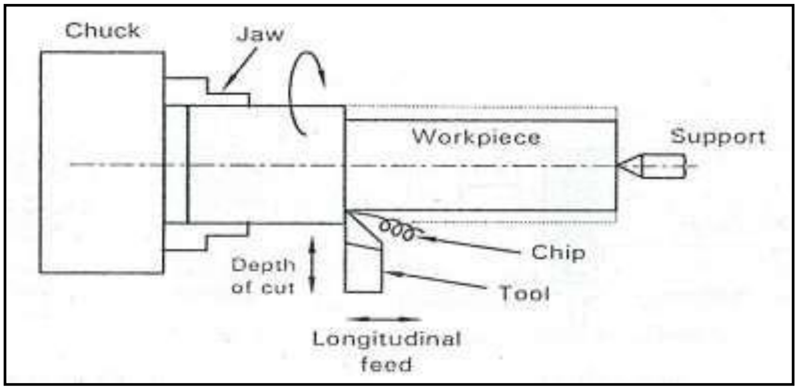
Several metal cutting operations are carried out to produce a mechanical part of required shape and size. The metal cutting operations may be carried out either manually by using hand tools such as chisels, files, saws etc… or using metal cutting machines. When machines perform the metal cutting operations by the cutting tools mounted on them, they are called machine tools. A machine tool may be defined as a power driven machine which accomplishes the cutting or machining operations on it. The fundamental machine tools that are used for most of the machining processes are given below

1. Lathe Machine.
2. Drilling Machine.
3. Grinding Machine.

LATHE MACHINE:

A lathe is a machine tool which turns cylindrical material, touches a cutting tool to it, and cuts the material. It is said to be the mother of all the machine tools. The lathe is the oldest of all machine tools and the most basic tool used in industries. A lathe is defined as a machine tool is primarily used to produce circular objects and is used to remove excess material by forcing a cutting tool against a rotating work piece. Lathes are also called turning machines, since the work piece is turned or rotated between two centers. since it is so versatile, that almost all the machining operations which are performed on other machine tools like, drilling, grinding, shaping, milling, etc., can be performed on it.

WORKING PRINCIPLE OF LATHE:



A lathe, basically a turning machine works on the principle that a cutting tool can remove material in the form of chips from the rotating work pieces to produce circular objects. This is accomplished in a lathe which holds the work pieces rigidly and rotates them at high speeds while a cutting tool is moved against it. Work piece held rigidly by one of the work holding devices, known as chuck, and is rotated at very high speeds. A cutting tool held against the work piece opposite to its direction of rotation when moved parallel to the axis of the work piece produces circular surfaces as shown in figure. The material of the tool will be harder and stronger than the material of the work piece.

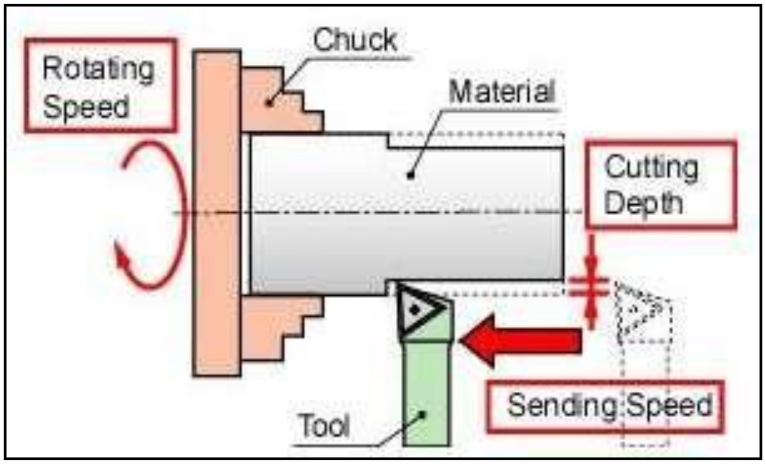
LATHE OPERATIONS: All most all the basic machining operations can be performed on a lathe. They are

1. Turning, 2. Taper turning 3.Thread cutting, 4. Boring, 5. Facing, 6. Drilling, 7. Reaming, 8. Knurling

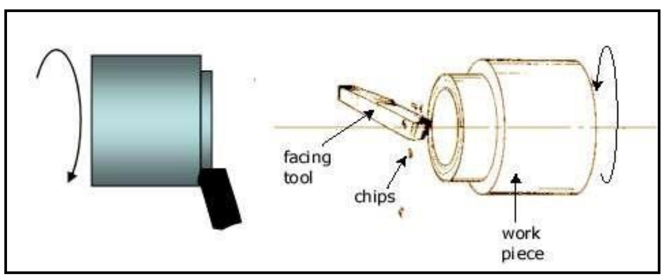
9. Milling, 10. Grinding

A variety of operations can be performed on a lathe. A few of them are discussed briefly below.

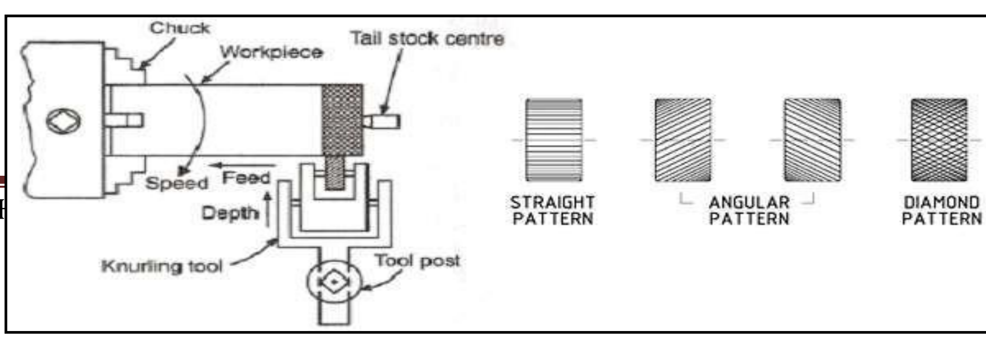
Turning: - Fig shows the principle of a metal cutting operation using a single-point tool on a lathe. The work piece is supported in between the two centres which permit the rotation of the work piece. A single point cutting tool is fed perpendicular to the axis of the work piece to a known pre-determined depth of cut, and is then moved parallel to the axis of the work piece. This operation will cut the material which comes out as shown fig. This method of machining operation in which the work piece is reduced to the cylindrical section of required diameter is called 'Turning’.



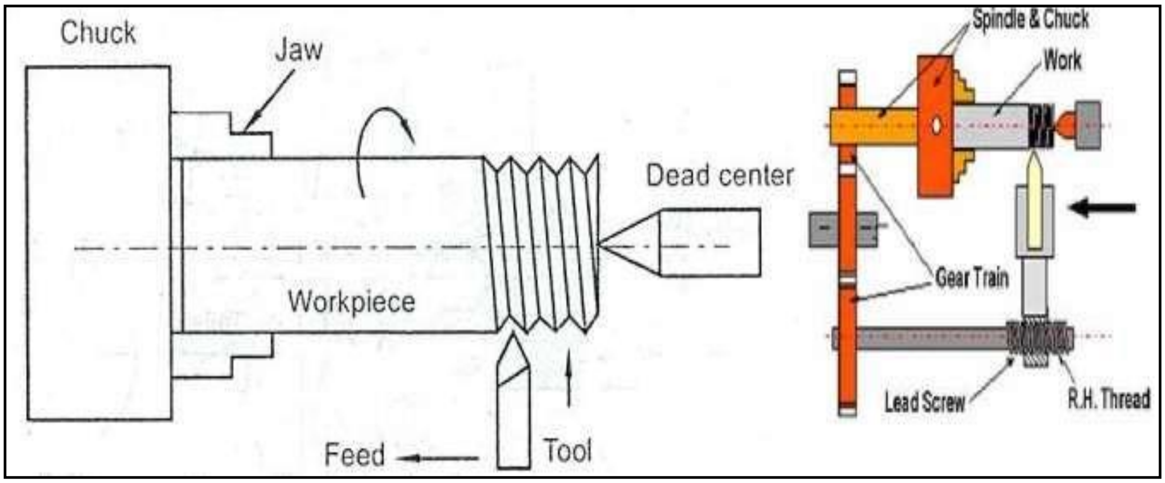
Facing: - Facing is defined as an operation performed on the lathe to generate either flat surfaced or shoulders at the end of the work piece. In facing operation, the direction of feed given is perpendicular to the axis of the lathe. The work piece is held in the chuck and the facing tool is fed either from outer edge of the work piece progressing towards the centre or vice versa. The cutting tool is held by a tool holder in a tool post.



Knurling: - Knurling is defined as an operation performed on the lathe to generate serrated surfaces on work pieces by using a special tool called knurling tool which impresses its pattern on the work piece. A typical knurling tool consists of one upper roller and one lower roller on which the desired impression pattern can be seen. The serration or impression pattern can be straight lines or diamond pattern.



Thread Cutting :- A thread is a helical ridge formed on a cylindrical or conical rod. It is cut on a lathe when a tool ground to the shape of the thread, is moved longitudinally with uniform linear motion while the work piece is rotating with uniform speed as shown in Fig. By maintaining an appropriate gear ratio between the spindle on which the work piece is mounted, and the lead screw which enables the tool to move longitudinally at the appropriate linear speed, the screw thread of the required pitch can be cut. The pointed tool shown in Fig is employed to cut V-threads. When square threads are to be cut, the tool is ground to a squared end.



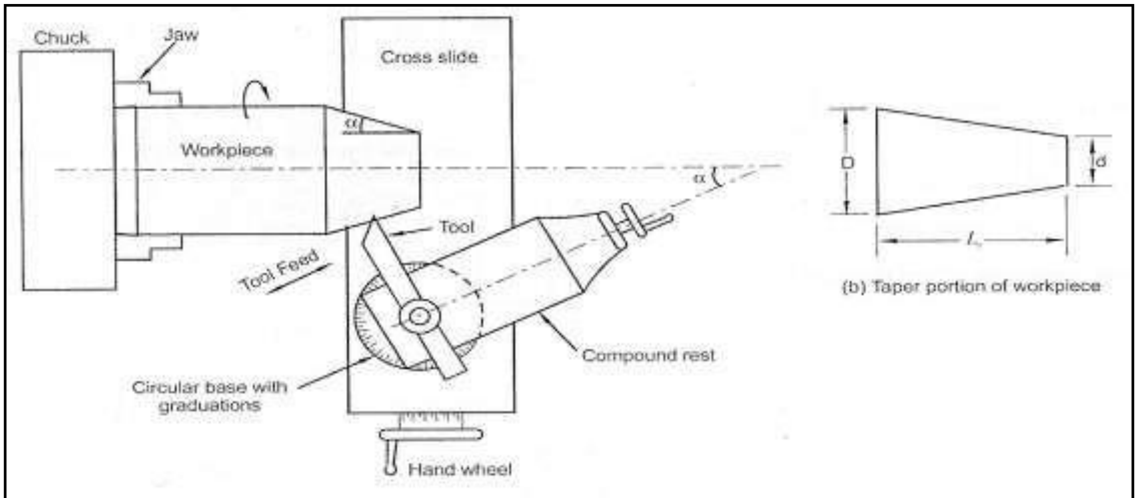
Taper turning: - Taper is defined as a uniform increase or decrease in diameter of a piece of work measured along its length. Taper turning is an operation on a lathe to produce conical surface on the work pieces.

Methods of Taper Turning: - 1) Taper Turning by setting over the tail Stock.

2) Taper Turning by swivelling the Compound Rest (Tool Post).

3) Taper Turning by a Taper turning attachment.

Taper Turning by the Swivelling the Compound Tool Rest:



(a) Top view of swivelled compound rest

This method of taper turning shown in Fig. It is more suitable for work pieces, which require steep taper for short lengths. The compound tool rest is swivelled to the required taper angle and then locked in the angular position. The carriage is also locked at that position. For taper turning, the compound tool rest is moved linearly at an angle so that the cutting tool produces the tapered surface on the work piece. This method is limited to short tapered lengths due to the limited movement of the compound tool rest.

The angle at which the compound rest to be swivelled is calculated using the equation given below

$$\tan\alpha = \frac{D-d}{2\times L} \quad \text{or} \quad \alpha = \tan^{-1} \frac{D-d}{2\times L}$$

Where

D = larger diameter of taper in mm

d = smaller diameter of taper in mm

L

=

l
e
n
g
t
h

o
f

t
a
p
e
r

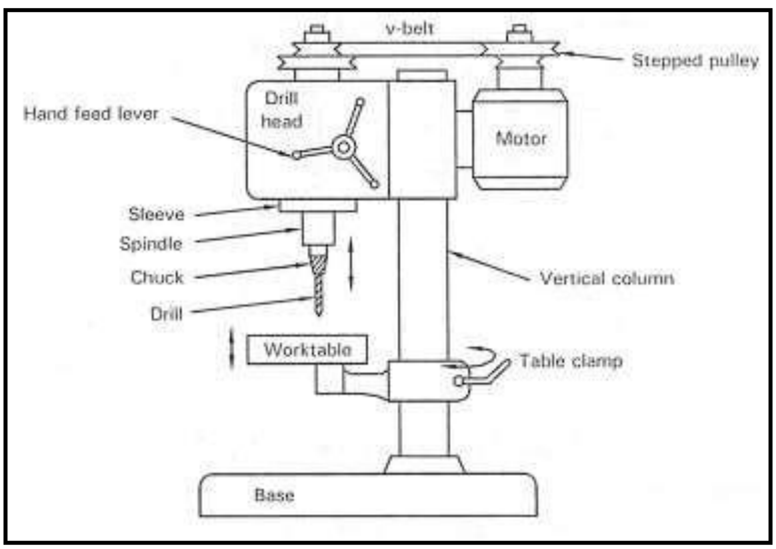
i
n

m
m
α = half of
taper angle
in degree

DRILLING MACHINE

INTRODUCTION: Drilling is a metal cutting process carried out by a rotating cutting tool to make circular holes in solid materials. The tool which makes the hole is called a drill. It is generally called as twist drill, Since it has a sharp twisted edges formed around a cylindrical tool provided with a helical groove along its length to allow the cut material to escape through tithe sharp edges of the conical surfaces ground at the lower end of the rotating twist drill cuts the material by peeling it circularly layer by layer when forced against a work piece. The removed material chips get curled and escapes through the helical groove provided in the drill. A liquid coolant is generally used while drilling to remove the heat of friction and obtain a better finish for the hole.

DRILLING MACHINE: Drilling machine is a power operated machine tool, which holds the drill bit in its spindle rotating at high speeds and when manually actuated to move linearly simultaneously against the work piece produces a hole, is called drilling machine.

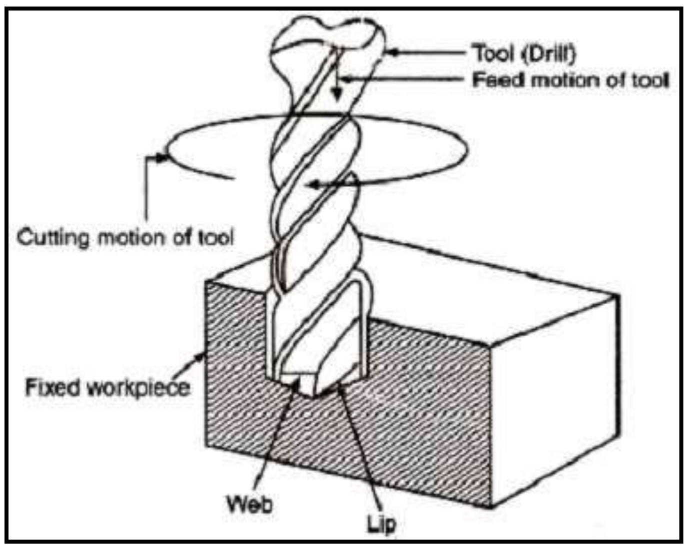


A twist drill shown in Fig.it is the cutting tool that is employed in the drilling machines. Two long diametrically opposite helical flutes are formed throughout its effective length. A twist drill is composed of three major parts-point, body and shank.

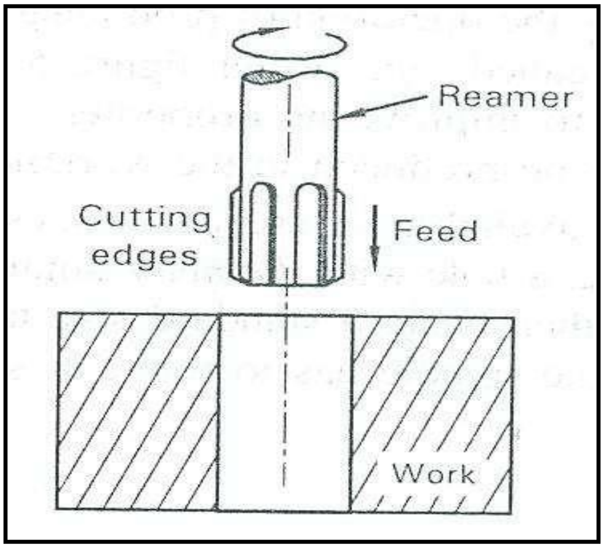
DRILLING MACHINE OPERATIONS: Apart from drilling, a number of other operations that can be performed on a drilling machine using the various tools are:

1) Reaming, 2) Boring, 3) Counter boring 4) Countersinking, 5) Spot facing & 6) Tapping.

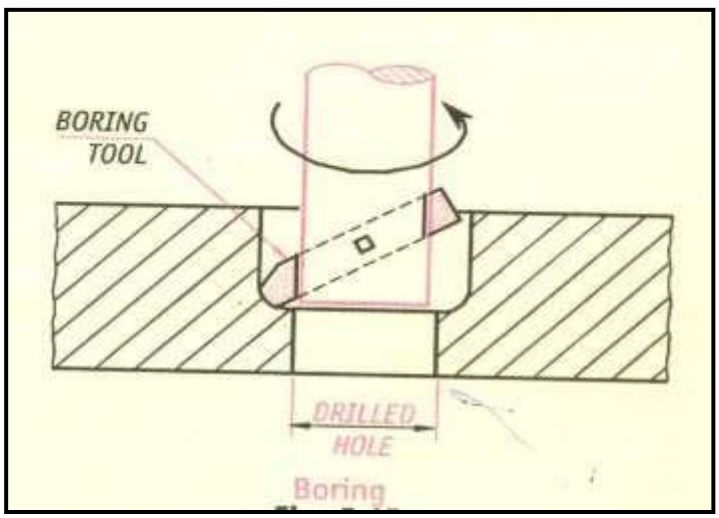
Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (swarf) from the hole as it is drilled.



Reaming: - Reaming is the process of smoothing the surface of the drilled holes with a reamer. A reamer is similar to the twist drill, but has straight flutes. After drilling the hole to a slightly smaller size, the reamer is mounted in place of twist drill and with the speed reduced to half of that of the drilling, reaming is done in the same way as drilling. It removes only a small amount of material and produces a smooth finish on the drilled surfaces.



Boring: - Boring is done on a drilling machine to increase the size of an already drilled hole. When a suitable size drill is not available, initially a hole is drilled to the nearest size and using a single point cutting tool, the size of the hole is increased as shown in Fig. By lowering the tool while it is continuously rotating, the size of the hole is increased to its entire depth. Fig shows when the boring operation is in progress. It will be continued till the lower surface of the work piece.



Counter boring: -Counter boring is to increase the size of a hole at one end only through a small depth as shown in Fig. The counter boring forms a larger sized recess or a shoulder to the existing hole. The cutting tool will have a small cylindrical projection known as pilot to guide the tool while counter boring. The diameter of the pilot will always be equal to the diameter of the previously drilled hole. Interchangeable pilots of different diameters are also used for counter boring holes of different diameters. The speeds for counter boring must be two-thirds of the drilling speed the corresponding size of the drilled hole. Generally the counter boring is done on the holes to accommodate the socket head screws, or grooved nuts, or round head bolts

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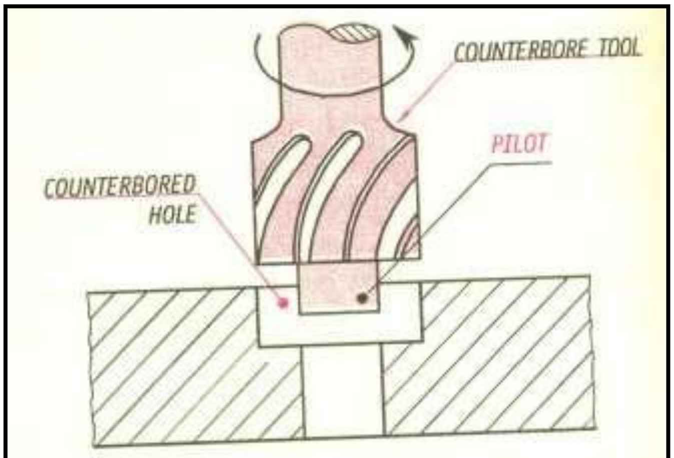
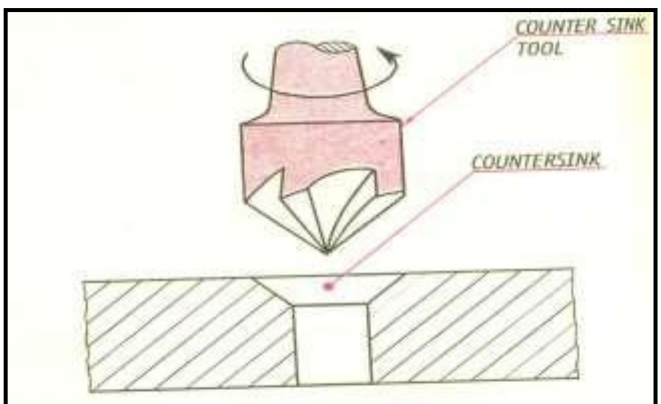


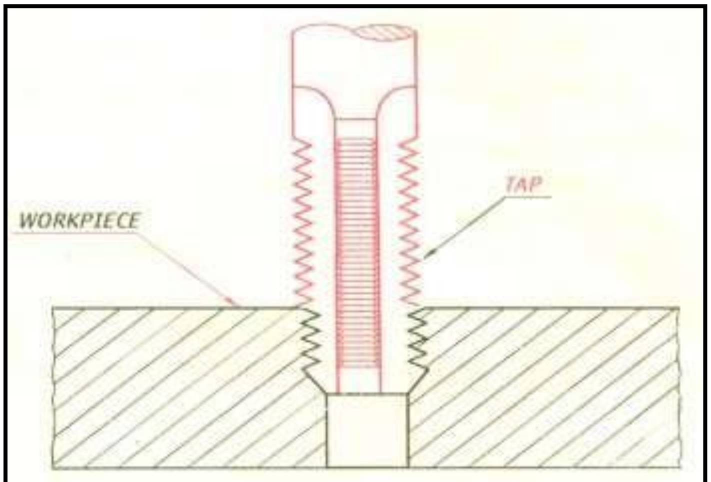
Counterboring

Countersinking: -Countersinking shown in Fig. it is the operation of making the end of a hole into a conical shape. It is done using a countersinking tool shown in figure. The countersinking process may also be employed for de burring the holes. The cutting speeds for countersinking must be about one-half of that used for similar size drill. The countersunk holes are used when the countersunk screws are to be screwed into the holes so that their top faces have to be in flush with the top surface of the work piece.

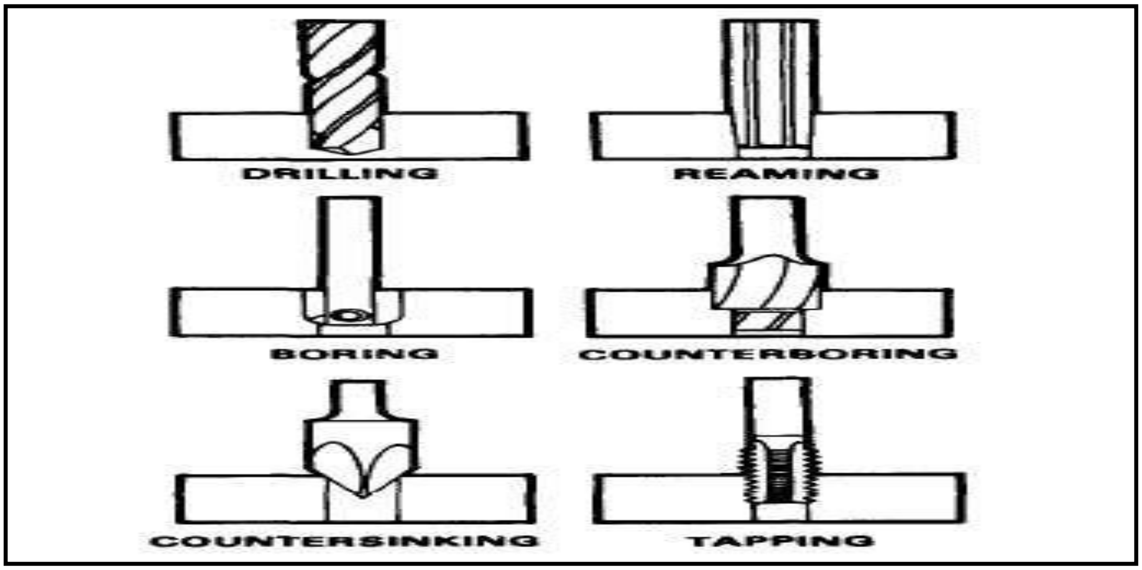


Countersinking

Tapping: - The tapping, shown in Fig. it is the process of cutting internal threads with a thread cutting tool called tap. A tap is a fluted threaded tool used for cutting internal threads. Before tapping, a hole which is slightly smaller than the size of the tap is drilled. For cutting the threads, the tap is fitted in the tapping attachment which in turn is mounted in the drilling machine spindle, and the threads are cut in the same way as drilling. While tapping in a drilling machine the spindle has to rotate at very slow speeds. The tap will be held in a collapsible type of tapping chuck, which is inserted in the spindle of the drilling machine. Generally tapping is done on a drilling machine when identical threading is required on large number of parts.



Tapping


DRILLING
REAMING
BORING
COUNTERBORING
COUNTERSINKING
TAPPING

SOLDERING, BRAZING AND WELDING

Soldering: - Soldering is a method of uniting two thin metal pieces using a dissimilar metal or alloy by the application of heat. The alloy of lead and tin is called soft solder, is used in varying proposition for sheet metal work, plumbing work and electrical junctions. The melting temp of the soft solder will be between 150 to 50 C. To clean the joint surfaces and to prevent oxidation a suitable flux is used while soldering. Zinc chloride is the flux that is commonly used in soft soldering. A soldering iron is used to apply the heat produced from the electrical source. An alloy of copper, tin, and silver known as hard solder is used for stronger joint. The soldering temp of hard solder ranges from 00 to 00 C

Method of soldering

a. Cleaning of joining surfaces
b. Application of flux
c. Tinning of surface to be soldered
d. Heating
e. Final clean-up

(i) Cleaning of joining surfaces: Firstly, the joining surface are cleaned mechanically to make free from dust, oil scale, etc. and ensure that the molten filler metal wets the surfaces.

(ii) Application of flux: Then the joining surfaces are coated with a flux usually rosin or borax. This cleans the surfaces chemically and helps the soldering making bond.

(iii) Tinning of surface to be soldered: before carrying out the soldering operation, the soldering iron must be tinned. This is to remove a thin film of oxide that forms on the copper bit, which in turns does not allow the job to be heated and thus it becomes difficult to solder. In tinning the copper bit is heated and then rubbed with a file to clean it properly and then rotating with solder using resin. This causes the formation of a thin film of solder over the copper bit. This whole process is called tinning

(iv) Heating: the soldering iron is then heated and flowing molten filler metals fills the joints interface. Allow the soldered area to cool and then solidify thus making the joint.

(v) Final clean-up: after completing the soldering and joints are formed, clean it with steel wool or solvent to remove left over flux. After this clean the soldering iron using a damp sponge.

Advantages of soldering

1. Low cost and easy to use
2. Soldered joints are easy to repair or do rework
3. The soldered joint can last for many year
4. Low energy is required to solder
5. An experienced person can exercise a high degree of control over the soldering process

Disadvantages of soldering

1. Not suitable for heavy sections
2. Temperature is limited
3. Strength is limited.

Brazing:- Brazing is the method of joining two similar or dissimilar metals using a special fusible alloy. Joints formed by brazing are stronger than that of soldering. During the brazing, the base metal of the two pieces to be joined is not melted. The filler metal must have ability to wet the surfaces of the base metal to which it is applied. Some diffusion or alloying of the filler metal with base metal takes place even though the base metal does not reach its melting temp. The materials used in brazing are copper base and **silver** base alloy. These two can be classified under the name spelter.

Method of brazing

1. Cleaning the surface of the parts.
2. Application of flux at the place of joint.
3. Common borax and mixture of borax and boric acid is used as flux.
4. The joint and the filler material are heated by gas welding torch above the melting temperature of the filler material.
5. It flows into the joint space and a solid joint is formed after cooling

Advantages of Brazing

1. It is easy to learn.
2. It is possible to join virtually any dissimilar metals.
3. The bond line is very neat aesthetically.
4. Joint strength is strong enough for most non-heavy-duty type of application.

Disadvantages of Brazing

1. Brazed joints can be damaged under high temp.
2. Brazed joint require a high degree of cleanliness.
3. The joint colour is often different from that of the base metal.

Welding: - Welding may be defined as the metallurgical joining of two metal pieces together to produce essentially a single piece of metal. Welding is extensively used in thefabrication working which metal plates, rolled steel sections, casting of ferrous materials are joined together. It is also used for repairing broken, worn out, or defective metal part.Principle of welding A welding is a metallurgical process in which the junction of the two parts to be joined are heated and then fused together with or without the application of pressure to produce a continuity of the homogenous material of the same composition and characteristics of the part which are being joined.

Types of welding

Welding are classified in to two type

• Pressure welding

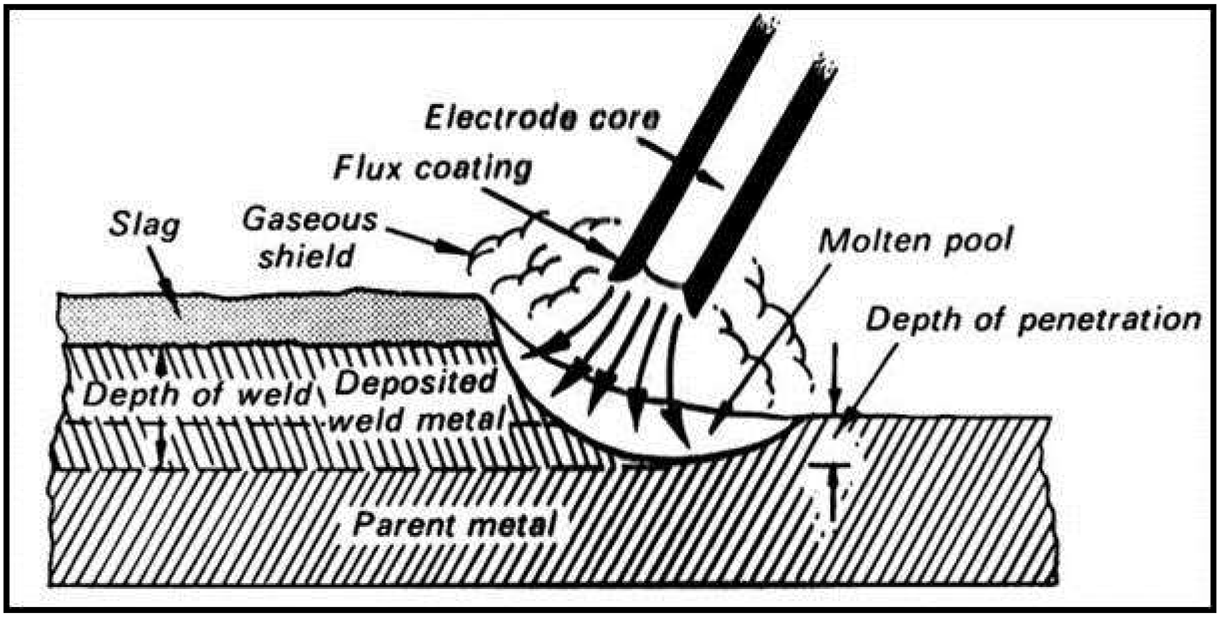
• Fusion welding

In Pressure welding the parts to be joined are heated only up to the plastic state and then fused together by applying the external pressure. Ex: forge welding, resistance welding

In Fusion welding which also known as non-pressure is welding, joints of the two parts are heated to the molten state and allowed to solidify.

Ex: arc welding, gas welding.

Arc welding: - The arc welding operates under the principle that when two conductor of an electric circuit are touched together momentarily and then instaneously separated slightly, assuming that there is sufficient voltage in the circuit to maintain the flow of current, an electric arc is formed. Concentrated heat is produced throughout the length of the arc at a temperature of about 5000 to 6000°C. In arc welding, usually the parts to be welded are wired as one pole of the circuit, and the electrode held by the operator forms the **other** pole. When the arc is produced, the intense heat quickly melts the work piece metal which is directly under the arc, forming a small molten metal of the electrode is carried over by the arc to the molten metal.



Pool of the work piece. The molten metal in the pool is agitated by the action of the arc, thoroughly mixing the base and the filler metal. A solid joint will be formed when the molten metal cools and solidifies. The flux coating over the electrode produces an inert gaseous shield surrounding the arc and protects the molten metal from oxidizing by coming in contact with atmosphere.

Arc welding machine

Both AC and DC are used for arc welding. For AC arc welding a step down transformer is used. It receives AC supply between 200 to 440V and transforms it to required low voltage of 80 to 100V. A high current of 100 to 400A is suitable for arc welding.

In DC arc welding work piece is connected to positive pole of DC generator and the electrode to the negative pole in order to melt greater mass of metal in the base metal, this setup is called straight polarity When the heat required is less in the base metal then the polarity is reversed Due to this option in DC arc welding it is possible to melt many metals In

AC there is no choice of polarity since the current changes every cycle.

Arc welding electrodes

There are two types of electrodes that are used in arc welding

(A) Consumable electrodes

(B) Non- consumable electrodes

Consumable electrodes are the electrodes which also melts along with the work piece and fill the joint Consumable electrodes could be either bare or coated. When bare electrodes are used globules of the molten metal while passing from the electrodes absorb oxygen and nitrogen from atmosphere Which gets trapped in the solidifying weld metal and thereby decreases the strength of the joint Electrodes are made up of soft steel or alloy steel The coating consists of chalk, starch, Ferro manganese and binding agents.

Coated electrode facilitates:

(a) Protection of molten metal from oxygen and nitrogen by providing a gaseous shield around the arc
(b) To establish and maintain the arc throughout the welding
(c) The formation of the slag over the joint thus prevents from rapid cooling
(d) Addition of alloying element

Non- consumable electrodes

When these are used, an additional filler material is also required Advantage in using this electrode is that amount of metal deposited can be controlled which is not possible in other type of electrode.

Resistance welding: - This type of welding employs the principles of both the pressure and fusion welding methods. It consist of heating of the Parts to be welded are heated up to the plastic state and joined by applying mechanical pressure. Heating is done by passage of heavy localized electric current, the current flowing from one part of joint to other encounters a high resistance and temp increases. This method is employed for fastening thin metal sheets and wires.

Gas welding: - It is a fusion welding, in which a strong gas flame is used to raise the temperature of the work piece to melt them. As in the arc welding, a filler metal is used to fill the joint. The gases that can be used for heating are

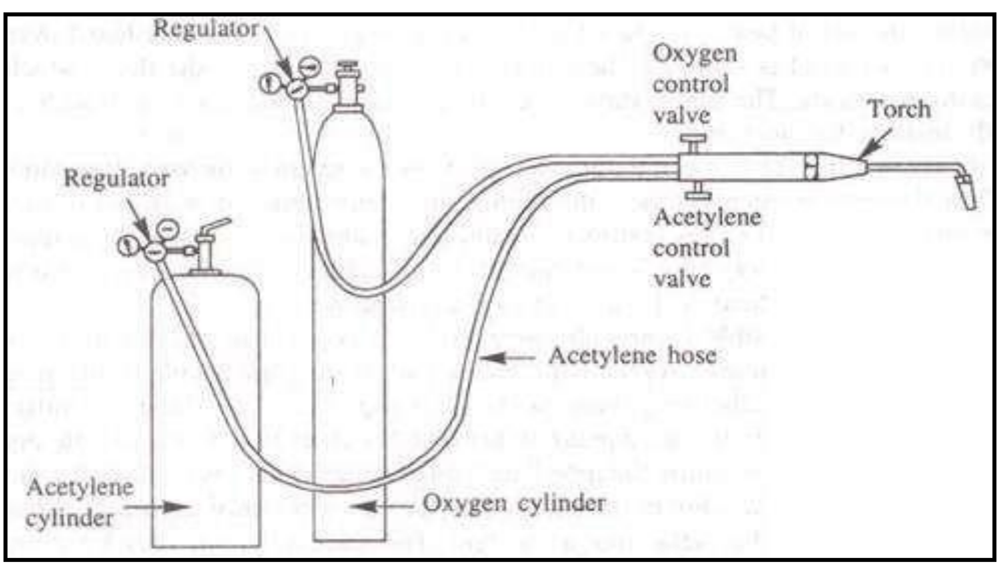
(i) Oxygen and acetylene

(ii) Oxygen and hydrogen.

Oxy-acetylene gas mixture is most commonly used in gas welding

Oxy-acetylene welding

When Right proportions of oxygen and acetylene are mixed in the welding torch and then ignited. The flame produced is called as the oxy-acetylene flame. The temperature attained in this welding is around 3200^0C hence has an ability to melt all commercial metals.



Types of oxy-acetylene flames

The types of flames depends on the gas ratio i.e. ratio of the parts of oxygen to the parts of the acetylene Depending on the gas ratio following flames are obtained.

(i) Neutral flame

(ii) Oxidizing flame

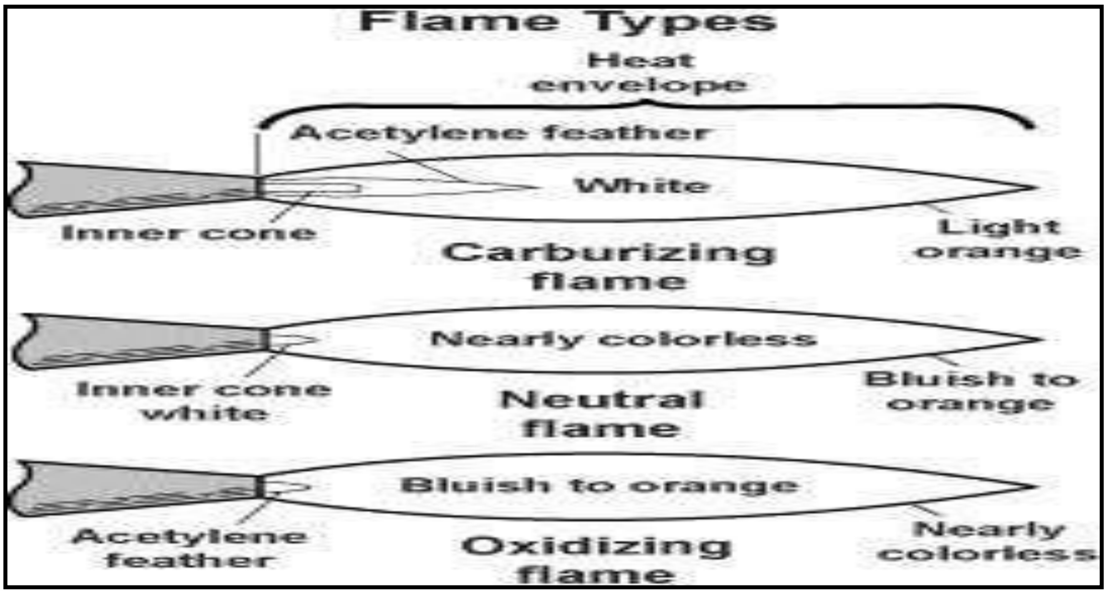
(iii) Reducing flame (carburizing flame).

(i) Neutral flame:-

- A neutral flame is obtained by supplying equal volume of oxygen and acetylene
- It consists of a small whitish inner cone surrounded by sharply defined blue flame
- Most of the gas welding is done using the neutral flame

(ii) Oxidizing flame

- This is obtained by supplying excess of acetylene in the gas ratio
- It has 3 cones, an inner white cone ,surrounded by an intermediate whitish cone known as " intermediate flame feather" and a bluish envelope flame
- This flame is used for welding alloy steels, cast iron, aluminium



(iii)Reducing flame:-

- This is obtained when there is excess of oxygen, gas ratio
- It appears to be similar to that of neutral flame but the inner white cone flame is shorter than that of neutral flame
- This flame is generally used in metal cutting rather than welding since weld metal gets oxidized

Advantages of oxy-acetylene welding

1. Most versatile process of welding with wide use in various manufacturing process
2. Low cost of the equipment and low cost of maintenance of the equipment
3. Because of separate heat source and filler metal the control can be exercised on the rate at which the filler metal deposits.
4. The rate of heating and cooling is slow. This help in retaining the structural homogeneity.
5. The equipment is portable and multi-functional because, apart from gas welding, it can also be used in torch brazing, braze welding, preheating and post heating.

Disadvantages

1. Difficult to attain low cost target while joining heavy section.
2. Handling and storage of gases not an easy job.
3. It takes long time for the flame to heat up the metal piece than compared to the arc welding.
4. Possible hazards due to explosion of gases.

SI. No.	Welding	Soldering	Brazing
1.	It is a high temperature process wherein the base metals are heated above their melting temperature.	Low temperature process. Base metals are not melted.	The base metals are not melted, but broadly heated to a suitable temperature.
2.	Filler metal used is of the same material as that of the base metal.	Filler metal is not the same as that of the base metal.	Filler metal is not the same as that of the base metal.
3.	Joint is formed by the solidification of the molten filler metal with the molten base metal.	Joint is formed by means of diffusion of the filler metal into the base metal.	Joint is formed by means of diffusion of the filler metal into the base metal associated with surface alloying.
4.	Strength of welded joint is much stronger than the base metal.	Strength of the soldered joint is comparatively low.	Strength of the brazed joint lies between that of welded and soldered joint.
5.	Since welding takes place at high temperatures, the metal adjacent to the weld portion called the *heat affected zone* is affected to a large extent.	There is no heat affected zone, as the process is carried at low temperatures.	Although base metals are heated, the heat affected zone is not too much when compared to welding.
6.	Welded joints require certain finishing operations like grinding, filing etc.	Joints can be used as is, without any finishing operations.	In some cases, brazed joints require finishing operations.
7.	Welding produces stronger joints. Hence the process is used for fabrication and structural applications	Joint formed is comparatively weak & hence used in light sheet metal applications & electronic industries.	Used in arts, jewelry works and in some industries.

MODULE – 4

Lubrication and Bearings

3.1. **Introduction:**

Whenever two metallic surfaces move over each other *friction* is produced due to direct contact. Friction is produced due to irregularities on the two moving or rotating surfaces. The main aim of lubrication is to avoid the direct contact between the parts. The life of the component depends on, how effectively the lubrication is applied to the parts (*Ex*: Life of scooter engine is about 50,000 to 75,000 km, but without lubrication the engine fails (seizure) within 1 to 3 km). The main purpose of lubrication is to reduce friction between the two or more moving parts.

3.2. **Functions / Purpose of Lubrication:**

The following are the functions of lubrication.

1 To reduce friction which consequently reduces the power required to overcome the same.
2 To reduce wear and tear between the rubbing and wearing surface.
3 To cool the surfaces by carrying away heat generated due to friction.
4 To carry away the particles of worn metal and carbon.
5 To seal space adjoining the surfaces such as piston moving in a cylinder.
6 To reduce the engine noise and to increase the engine life.
7 To avoid corrosion and deposits.

3.3. **Properties of Lubricants:**

The various properties of lubricants are listed below.

1 **Viscosity**: It is the measure of the degree of fluidity of a liquid. Viscosity of lubricating oil decreases with increase in temperature.
2 **Flash point**: Flash point is the temperature at which the oil gives off sufficient vapor to ignite momentarily on introduction of a flame.
3 **Fire point**: Fire point is the temperature at which the entire fluid will catch fire.
4 **Pour point**: It is the lowest temperature at which the oil ceases to flow is known as pour point.
5 **Cloud point**: It is the lowest temperature at which oil becomes cloudy is known as cloud point.
6 **Oiliness**: It is the property of a liquid due to which it wets the surface and adheres to it.

3.4. **Requirements / desirable properties of a good lubricant are as follows:**

1 The lubricant should have good viscosity to maintain a thin film at various pressure and temperature conditions.
2 The lubricant should have high flash and fire point.
3 The lubricant should have low cloud and pour point.
4 The lubricant should be free from acids.
5 The lubricant should be highly resistant to emulsion.
6 The lubricant should be chemical stability against oxidation.

3.5. **Types of lubricants used in various needs are listed below:**

1 **Animal oils**:
These are obtained from animal fat. These lubricants get easily oxidized causing them to become gummy after use. Hence this lubricant is not advisable to use for machines.

2 **Mineral oils**:
Mineral oils are derived from petroleum are perhaps used in various applications. The main constituents of mineral oils are hydrocarbons. According to their molecular structure they may be further classified into paraffin's, naphthenes, aromatics and olefins. Few advantages of mineral oils are

a. Greater chemical stability.
b. Less tendency to form emulsion with water.
c. Do not attack the metals or cause chemical reaction.

3 **Vegetable oils**:
These oils are obtained from plants, seeds and fruits. Various vegetable oils available are olive oil, linseed oil castor oil etc., except castor oil all vegetable oils gets oxidizes easily, makes them unsuitable for engines.

4 **Synthetic lubricants**:
These are the lubricants prepared by synthetic process. These lubricants possess excellent lubricating properties; hence it is widely used in almost all the applications. The synthetic lubricants are silicon fluids, polyglycol ethers and aliphatic diesel.

5 Solid lubricants:
These lubricants are used where speed is low, pressure and temperature are high. Generally used solid lubricants are graphite, molybdenum disulphide and mica.

6 Greases:
Grease is essentially lubricating oil having certain thickening agents like calcium or sodium soaps. Grease is widely used in lubricating automobiles. Greases are classified according to the purpose for which they are used, and the kind of soap base. Calcium base greases are widely used for chassis lubrication and for lubrication for wheel bearings. Sodium based greases can with stand high temperatures and is suitable for lubricating universal joints and for lubricating brake cables.

3.6. **Drop Feed Lubricator:**

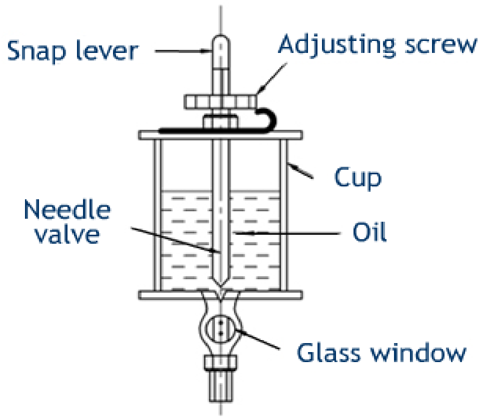


Figure 1

Figure 1 shows a drop feed lubricator. It consists of a glass cup containing oil, needle, adjusting screw, glass window, lever, etc. When the snap lever is raised, the needle is lifted and oil flows through the hole. The flow of oil is observed through a glass window. This type of lubricator is mounted directly above the part to be lubricated. One advantage of this lubricator is that the oil flow can be easily visualized through the window, and the oil level can be checked frequently through the glass container.

3.7. Splash lubricator

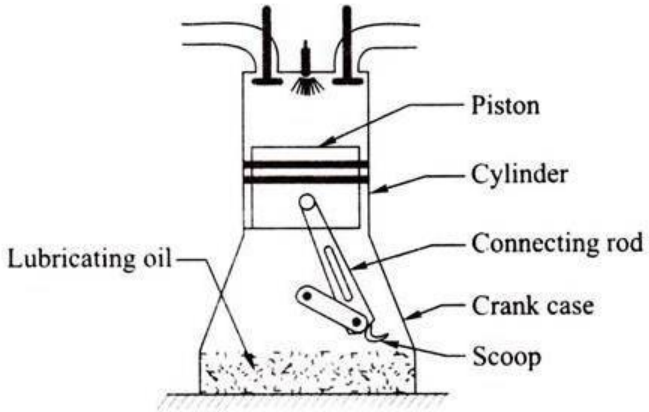


Figure 2

The splash lubricator is used in four stroke internal combustion engines. Figure 2 shows the splash lubrication method. In this method of lubrication required amount of lubricant is filled in the crankcase. A hook, casted or bolted onto the crankshaft, dips into the oil in the sump and splashes it around the inside of the engine. The splashed oil reaches cylinder liner, piston, piston ring and connecting rod bearings and thus lubrication is achieved.

Bearings

3.8. Introduction:

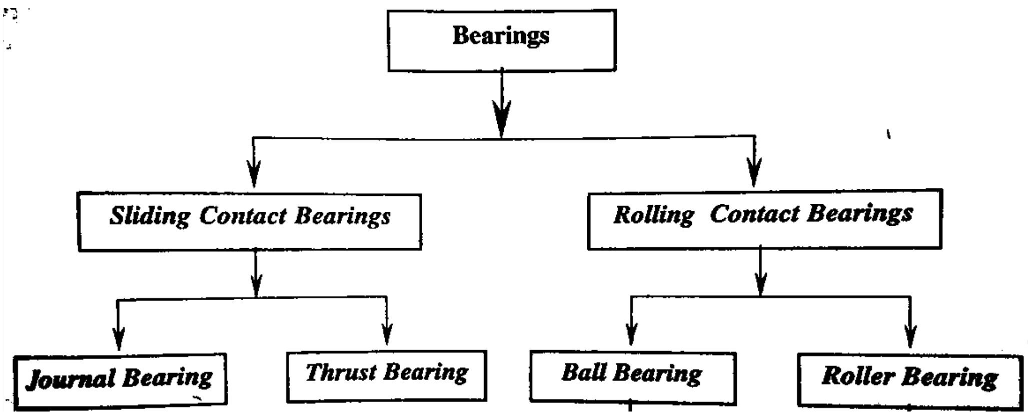
Bearing is a universal component used in almost all machineries we see in our daily life. It is a machine element which supports the rotating shaft. All rotating shafts will be supported by bearings. Bearing may be a bush bearing, thrust bearing, collar bearing, roller bearing, needle bearing etc., The bearings should permit smooth rotation of the shaft. To reduce the wear of the bearing lubrication is provided. All the bearings are designed to run lakhs of revolutions without any slackness. In partial lubrication, the coefficient of friction lies between 0.14 to 0.4, according to this the bearing is not completely separated by a thin film of oil. In fully lubricating bearings, the coefficient of friction lies between 0.02 to 0.1, according to this the bearing is completely separated by a thin film of oil and grease. In such bearings the wear is almost eliminated.

3.9. Requirements of bearings:

a. They should provide minimum deflection under loads.
b. They should have sufficiently long service.
c. They should provide simple and convenient assembly.
d. They should possess adjustability to obtain minimum radial and axial slackness

3.10 Classification of bearings:

Bearings are classified according to the nature of contact surfaces as follows:



3.11 Sliding Contact Bearings

In sliding contact bearings, the motion between the shaft and the bearing is purely sliding. The friction in sliding contact bearings is quite high hence more lubrication has to be provided. The sliding contact bearings are classified according to the type of load acting on the bearings. Different types of loads acting on the bearings are transverse load and axial load.

3.11.1. Journals:

A journal bearing is one in which load acts perpendicular to the axis of the shaft. Portion of the shaft which is in actual contact of the bearing is known as journal. Commonly used journal bearing are *Bushed bearings* and *Plummer block*.

Bushed Bearing:

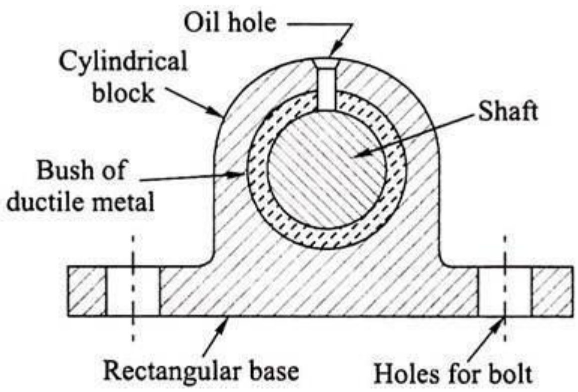


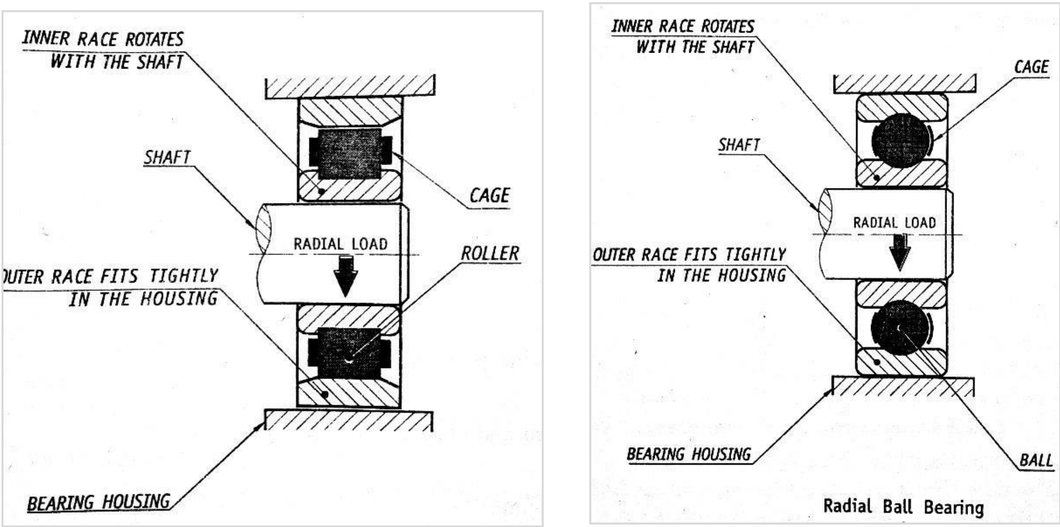
Figure 3

It is the simplest types of journal bearing. Simplest type of bushed bearing is as shown in Figure 3. The bearing may be only a hole in a block, where the load to be carried is always in one direction. These are also called as plain bearings. The main parts of the bushed bearing are bearing block, bush and shaft. The bearing (bush) is fitted in the bearing block either by a screw or by press fit. The shaft is supported by a bushed bearing, which is lubricated by oil or grease. When the bush worn out it can be easily replaced by a new one. The bush is made of soft material like brass or bronze.

3.12. Rolling Contact or Antifriction Bearing:

The term ‘‘rolling element bearings’’ is used to describe that class of bearings in which the moving surface is separated from the stationary surface by elements such as balls, rollers, or needles that can roll in a controlled manner. These bearings are often referred to as ‘‘antifriction’’ bearings. When a rolling element bearing is properly lubricated, its load capacity and life are limited primarily by the fatigue strength of the bearing steel. Rolling contact bearings are classified into ball bearings and roller bearings.

3.12.1. Roller Bearing:



(a) (b)

Figure 4 (a). Roller bearing and (b). Ball bearing

Roller bearing is as shown in Figure 4a. The essential parts of roller bearing are inner race, outer racer, and a set of rollers. The rollers are held between the inner and outer racer. The rollers are held in position by a cage. The inner racer is drive fit on the shaft and the outer racer is firmly secured in the bearing housing. The roller bearings are designed to take more loads than ball bearings.

3.12.2. Ball Bearing

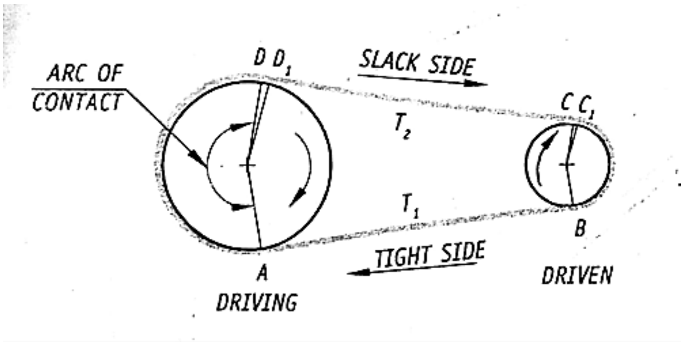
A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races (Figure 4b). The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. The essential parts of ball bearing are inner race, outer racer, and a set of balls. The balls are held between the inner and outer racer. The balls are held in position by a cage. The inner racer is drive fit on the shaft and the outer racer is firmly secured in the bearing housing.

Belt drives

Belt drives are one of the common methods generally employed whenever power or rotary motion is to be transmitted between two parallel shafts.

Open Belt Drive

- This type of belt drive shown in fig. is employed when the two parallel shafts have to rotate in the same direction.
- When the shafts are placed far apart, the lower side of the belt should be the tight side and the upper side must be the slack side.
- This is because, when the upper side becomes the slack side, it will sag due to its own weight and thus increases the arc of contact which in turn increases the capacity of the drive.



Crossed Belt Drive

- This type of belt drive shown in fig. is employed when two parallel shafts have to rotate in the opposite direction.
- At the junction where the belt crosses, it rubs against itself and wears off.
- To avoid excessive wear the shaft must be placed at a maximum distance from each other and operated at very low speeds.

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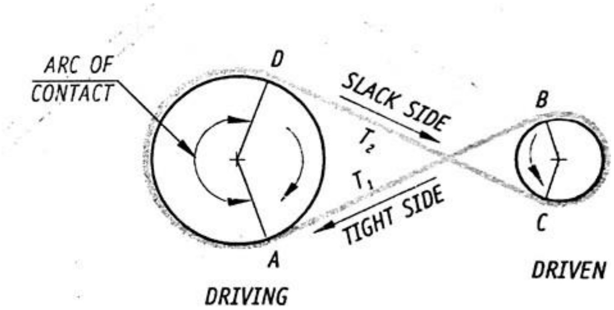


Definitions:

Slip: It is defined as the difference between the tensions in the tight and slack sides of the belt is equal to the force of friction.

Creep*:* In the belt drive, the straight portions of the belt will be alternately subjected to higher and lower tensions. The slack side of the belt, having the lower tension T_2 as soon as it enters the driven pulley, will be subjected to a gradual increasing tension from T_2 to T_1.

Velocity ratio: It is defined as the ratio of the speed of the driving pulley to the speed of the driven pulley.

$$\text{Velocity ratio} = \frac{\square_1}{\square_2}$$

Open Belt System.

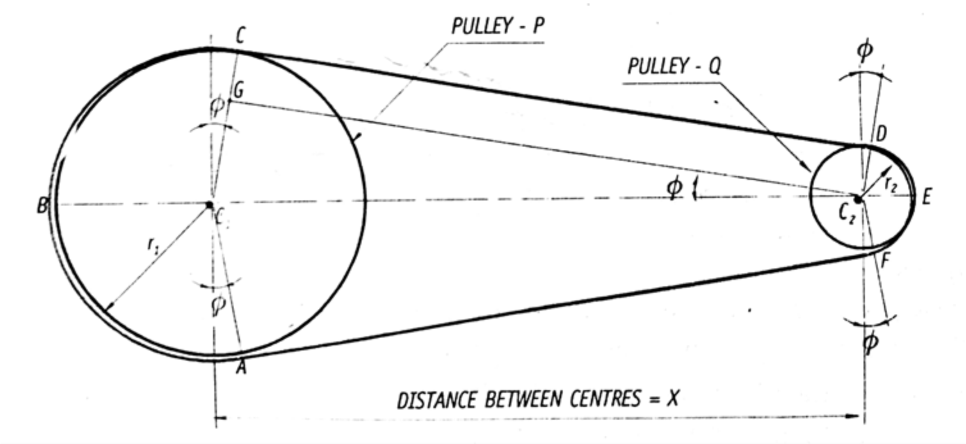
Let the two pulleys P and Q be connected by an open belt as shown in Fig. from the centre O, of the smaller pulley draw a line O_2G parallel to CD.

Let, r_1 = radius of the large pulley *P*

r_2 = Radius of the smaller pulley Q

X = Distance between the centers of the pulleys

From the geometry of the belt drive shown in fig. the length of the belt is given by,



PULLEY - P
PULLEY - Q
C
G
D
B
E
F
A
r1
r2
C2
DISTANCE BETWEEN CENTRES = X

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L = Arc Length ABC + Length CD + Arc Length DEF + Length FA

= 2[Arc length BC + Length CD + Arc length DE]

$$= 2\left[\left(\frac{\Pi}{2}+\phi\right)r_1 + lengthCD + \left(\frac{\Pi}{2}-\phi\right)r_2\right]$$

$$= 2\left[\left(\frac{\Pi}{2}+\phi\right)r_1 + lengthGC_2 + \left(\frac{\Pi}{2}-\phi\right)r_2\right] \qquad (\because CD = GC_2)$$

$$= 2\left[\left(\frac{\Pi}{2}+\phi\right)r_1 + X\,Cos\,\phi + \left(\frac{\Pi}{2}-\phi\right)r_2\right] \qquad \left(\because \frac{GC_2}{X} = Cos\phi\right)$$

$$= 2\left[\frac{\Pi}{2}(r_1+r_2)+\phi(r_1-r_2)+X\,Cos\phi\right] \quad 1$$

$$= \Pi(r_1+r_2)+2\phi(r_1-r_2)+2X\,Cos\phi$$

From the triangle GC_1C_2

$$Sin\phi = \frac{r_1-r_2}{X}$$

$$\phi = Sin^{-1}\frac{r_1-r_2}{X} = \frac{r_1-r_2}{X} \qquad \because (\phi \text{ is small}) \quad 2$$

$$Cos\phi = [1-Sin^2\phi]^{1/2}$$

$$= \left[1-\frac{1}{2}Sin^2\phi\right] \qquad \text{(By Binomial Theorem and neglectinghigher power)}$$

$$= \left[1-\frac{1}{2}\left(\frac{r_1-r_2}{X}\right)^2\right] \quad 3$$

Substituting equ[n]. (2) and (3) in (1)

$$L = \Pi(r_1+r_2)+2\frac{(r_1-r_2)}{X}(r_1-r_2)+2X\left[1-\frac{(r_1-r_2)^2}{2X^2}\right]$$

$$= \pi\left(r_1 + r_2\right) + 2\frac{\left(r_1 - r_2\right)^2}{X} + 2X - \frac{\left(r_1 - r_2\right)^2}{X}$$

$$\boxed{L = \pi\left(r_1 + r_2\right) + \frac{\left(r_1 - r_2\right)^2}{X} + 2X}$$

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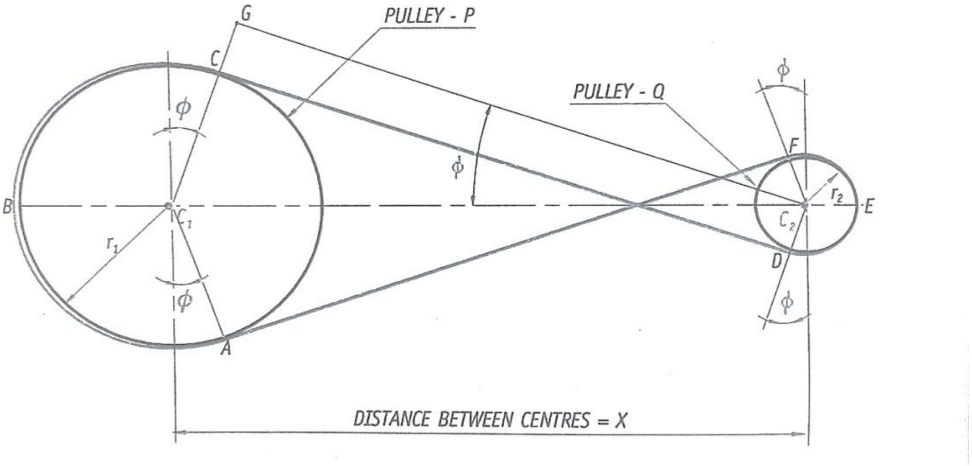
Crossed Belt Systems

Let the two pulleys P and Q are connected by a crossed belt as shown in Fig. from the centre C_2 of the smaller pulley, draw a line C_2G parallel to CD.



Let,

r_1 = radius of the larger pulley P

r_2 = Radius of the smaller pulley Q

X = Distance between the centres of the two pulley

From the geometry of the belt drive shown in Fig., the length of belt is given by.

L = Arc length ABC + Length CD + Arc length DEF + Length FA

= 2[Arc length BC + length CD + Arc length DE]

$$= 2\left[\left(\frac{\Pi}{2}+\phi\right)r_1 + \text{Length CD} + \left(\frac{\Pi}{2}+\phi\right)r_2\right]$$

$$= 2\left[\left(\frac{\Pi}{2}+\phi\right)(r_1+r_2) + \text{Length CD}\right]$$

$$= 2\left[\left(\frac{\Pi}{2}+\phi\right)(r_1+r_2) + \text{Length } GC_2\right] \qquad (\because CD = GC_2)$$

$$= 2\left[\left(\frac{\Pi}{2} + \phi\right)(r_1 + r_2) + X\ Cos\phi\right] \qquad \left(GC_2 = Cos\phi\right)$$

$$= [(\Pi + 2\phi)(r_1 + r_2) + 2X\ Cos\phi] \qquad Equ^{n}.(1)$$

From the triangle GC_1C_2,

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$$Sin\phi = \frac{r_1 + r_2}{X} \qquad (\because \phi \text{ is small})$$

$$\phi = Sin^{-1}\frac{r_1 + r_2}{X} = \frac{r_1 + r_2}{X} \qquad Equ^{n}.(2)$$

$$Cos\phi = [1 - Sin^2\phi]^{1/2} \qquad \text{(By Binomial Theorem and neglecting higher powers)}$$

$$= \left[1 - \frac{1}{2}Sin^2\phi\right]$$

$$= \left[1 - \frac{1}{2}\left(\frac{r_1 + r_2}{X}\right)^2\right]$$

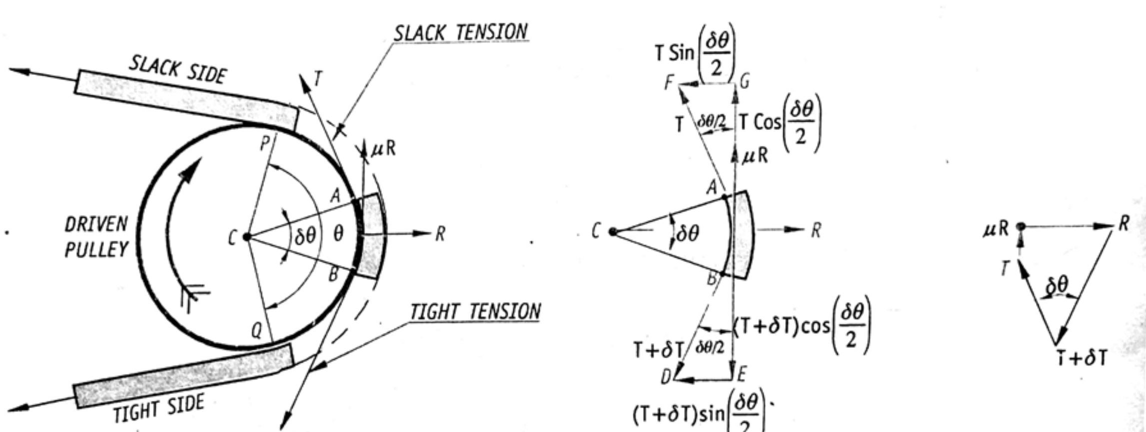
Substituting (2) and (3) in (1)

$$L = \left[\Pi + 2\left(\frac{r_1 + r_2}{X}\right)\right](r_1 + r_2) + 2X\left[1 - \frac{(r_1 + r_2)^2}{2X^2}\right]$$

$$L = \Pi(r_1 + r_2) + 2\left[\frac{(r_1 + r_2)^2}{X}\right] + 2X - \left[\frac{(r_1 + r_2)^2}{X}\right]$$

$$\boxed{L = \Pi(r_1 + r_2) + \left[\frac{(r_1 + r_2)^2}{X}\right] + 2X}$$

RATIO OF TENSIONS IN BELT DRIVES:



The ratio of tensions on the tight side to that of the slack side is called the ratio of tensions.

Let upper side be the tight side and lower side be the slack side.

Let,

T_1 = Tension on the tight side

T_2 = Tension on the slack side θ = Angle of contact in ratios

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Consider an elemental length CD of the belt as shown in fig. Let the angle of contact of this element be δɵ. Let T and δT be the tensions on slack side and tight sides respectively.

Let µ = coefficient of traction between the belt surface and the pulley surface. The acting on the element are:

i) Tension on the slack side = T
ii) Tension on the tight side = T + δT
iii) Normal reaction force existed by pulley on the belt = R
iv) the force of friction µR acting perpendicular to R

For the equilibrium of the element, the resultant force along horizontal and vertical directions must be equal to zero.

i.e., $\sum F_H = 0$ and $\sum F_V = 0$

$$\sum F_H = R - T\sin\frac{\delta\theta}{2} - (T+\delta T)\sin\frac{\delta\theta}{2}$$

i.e.,

$$R = T\sin\frac{\delta\theta}{2} + (T+\delta T)\sin\frac{\delta\theta}{2}$$

$$= 2T\sin\frac{\delta\theta}{2} + (\delta T)\sin\frac{\delta\theta}{2}$$

Since the angle δɵ is very small.

$\sin\frac{\delta\theta}{2} \approx \frac{\delta\theta}{2}$ and the product $\delta T \sin\frac{\delta\theta}{2}$ can be neglected

$\therefore$

$$R = 2T\frac{\delta\theta}{2}$$

$$R = T\delta\theta \qquad \text{Equ. (1)}$$

Now $\sum F_V = 0$

i.e.

$$\mu R + T\cos\frac{\delta\theta}{2} - (T+\delta T)\cos\frac{\delta\theta}{2} = 0$$

i.e.,

$$\mu R - (\delta T)\cos\frac{\delta\theta}{2} = 0$$

or,

$$\mu R = (\delta T)\cos\frac{\delta\theta}{2}$$

 $angle\ \frac{\delta\theta}{2}\ is$ small

$$\cos\frac{\delta\theta}{2} = 1$$

$\therefore$

$$\mu R = \delta T \qquad \text{Equ. (2)}$$

From Equ. (1) and (2)

$\mu T \delta\theta =$ Equ. (3)

δT

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For the total length of contact AB, of the belt for which the angle of contact varies from 0 to θ and the tension varies from T_2 to T_1, integrating the equation (3).

$$\int_{T_2}^{T_1} \frac{\delta T}{T} = \int_0^{\theta} \mu \delta\theta$$

i.e.,

$$\ln\left(\frac{T_1}{T_2}\right) = \mu\theta$$

$$\boxed{\left(\frac{T_1}{T_2}\right) = e^{\mu\theta}}$$

Taking logarithm on both sides,

$$\log\left(\frac{T_1}{T_2}\right) = \mu\theta \log e$$

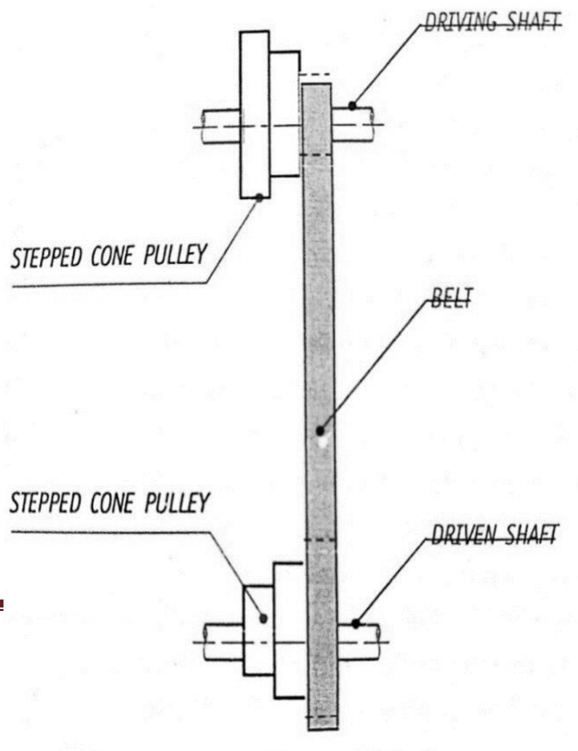
$$\log\left(\frac{T_1}{T_2}\right) = \mu\theta \log 2.718281$$

$$\log\left(\frac{T_1}{T_2}\right) = \mu\theta * 0.4343$$

$$\boxed{\log\left(\frac{T_1}{T_2}\right) = 0.4343 * \mu\theta}$$

Stepped Cone Pulley or Speed Cone Pulley:

- A stepped cone pulley also called a speed cone, shown in fig.
- It is used when the speed of the driven shaft is to be changed very frequently as in the case of machine tools such as lathe, drilling machine etc.,
- A stepped cone pulley is an integral casting having three or more number of pulleys of different sizes one adjacent to the other as shown in fig.
- One set of stepped cone pulleys is mounted in reverse on the driven shaft.
- An endless belt will be wrapped around one pair of pulleys.



Stepped Cone Pulley

- By shifting the belt from one pair of pulley to the other, the speed of the driven shaft can be varied.
- The diameters of the driving and driven pulleys are such that same belt will operate when shifted on different pairs of pulleys.

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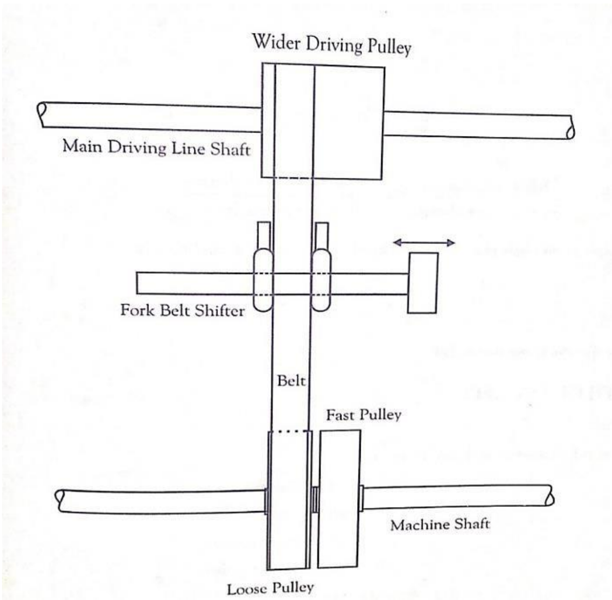
Fast and Loose Pulley:

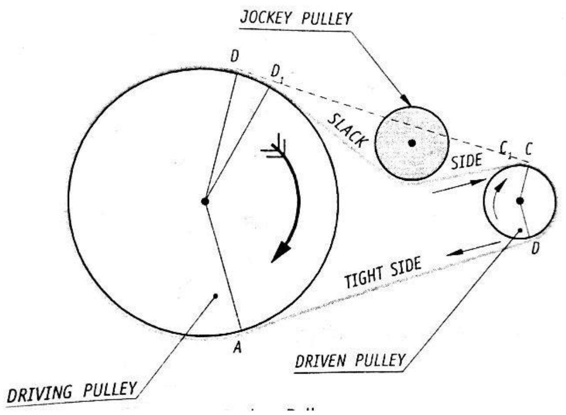
- When a number of machines obtain the drive from a main driving shaft, often it may require to run some of the' machines intermittently without having to *start and stop*" the main driving shaft every time.
- This can be accomplished by mounting two pulleys known as fast and loose pulley.
- When the belt is on the fast pulley, the power is transmitted to the machine shaft.
- When the machine shaft is to be brought to the rest, the belt is shifted from the fast pulley to the loose pulley.



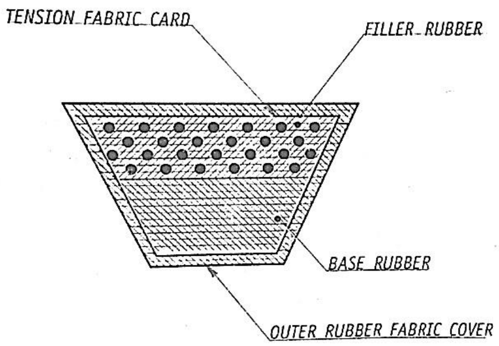
- The axial movement of the loose pulley towards the fast pulley is prevented by adjacent to its boss that of the fast pulley

Jockey Pulley:

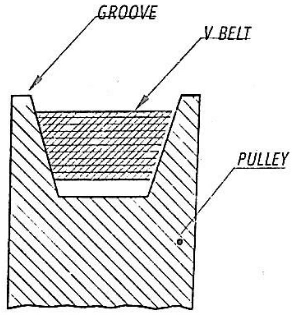
In an open belt drive arrangement, if the centre distance is small, or if driven pulley is very small, then the arc of contact of the belt with the driven pulley will be very small, which reduces the tensions in the belt, or if the required tension of the belt cannot be obtained by other means, an idler pulley, called jockey pulley is placed on the slack side of the belt as shown in fig. This increases the arc of contact and thus the tensions which results in increases power transmission



V- Belts:



Section of V-Belt



V-Belt in Groove

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- These appear trapezoidal in cross section. These are moulded as endless loops from rubber, reinforced with fibrous material.
- These belts run in the V-grooved pulleys or sheaves.
- Multiple V-belts are used when the power transmitted is too great for a single belt.
- Power from 0.5 to 150 kW can be transmitted using V-belts
- It is used for general engineering applications, from domestic appliances to heavy duty rolling machines.

Advantages

1. It can transmit higher power
2. It can be used for smaller centre distances
3. It can permit large speed ratios
4. There is no slipping of the belt from the pulley
5. In an emergency it is possible to continue the drive temporarily even if one of the belts snap
6. It is possible to operate with the shaft axes in any position
7. Several machines can be driven from a single driving shaft

Disadvantages

1. The pulley construction is more complex in a V-belt drive when compared to flat belt drive
2. Durability of V-belts is less compared to flat belts
3. Not suitable for large center distances
4. It is a costlier system than flat belt drive.

Gear drives

- Gear drives find a very prominent place in mechanical power transmission.
- Gear drives are preferred when considerable power has to be transmitted over a short centre distance positively with a constant velocity ratio.

Types of Gears

There are various types of gears to suit various applications. They differ in the shape of the gear wheel like cylindrical or conical or elliptical, the orientation of their axes and the angle at which the teeth mesh, Gear drives transmit power between the shafts when their axes are: 1) parallel or 2) intersecting or 3) neither parallel nor intersecting. The different types of Gears used in these cases are:

1. *Spur Gears* - For parallel axes shafts
2. *Helical Gears* - For both parallel and Non-parallel and Non-intersecting Axes shafts

3. *Bevel Gears* – For Intersecting Axes shafts

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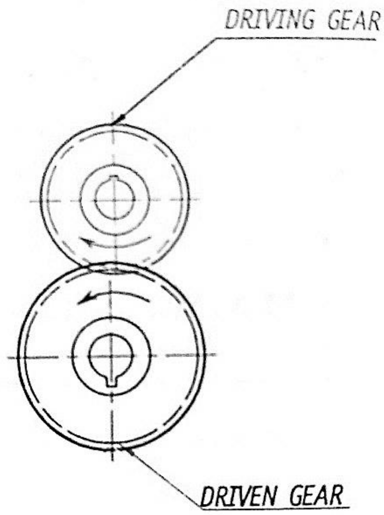
4. *Worm Gears* – For Non-Parallel and Non-co-planar Axes shafts.
5. *Rack and pinion* – For converting Rotary motion into linear motion.

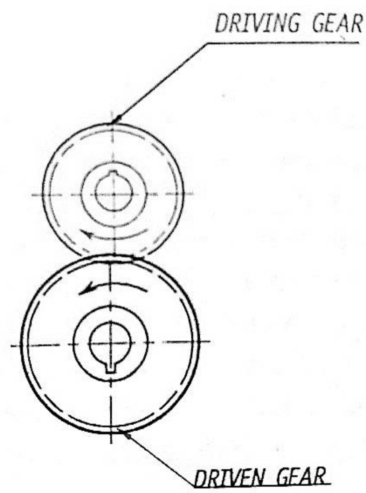
1. Spur Gears:

- When the axes of the driving and driven shafts are parallel and co-planar as shown in Fig. 1. and the teeth of the gear wheels are parallel to the axes, the gears are called Spur Gears.
- Teeth of the spur gears are cut on the circumference of the cylindrical discs.
- The contact between the mating gears will be along a line, hence spur gears can transmit higher power.
- Because of the instantaneous line contact when the teeth mesh, noise will be very high.
- They are widely used in machine tools, automobile gear boxes and in all general cases of power transmission where gear drives are preferred.



2. Helical Gears:

- Helical gears are similar to the spur gears except that the teeth are cut in the form of the helix around the gears as shown in Fig. 2.
- Helical gears are used for transmitting power between two parallel shafts and also between non-parallel, non-intersecting shafts.
- The curvilinear tooth contact is progressive, i.e., it extends diagonally across the meshing teeth starting first at one end of a pair of engaging teeth, then, a little further along and so on, progressively to the end of the particular tooth.
- Helical gears are preferred to spur gears when smooth and quite running at higher speeds are necessary.
- The main disadvantages of the helical gears are that it produces and thrusts on the driving and driven shafts.
- Generally they are used in automobile power transmission.



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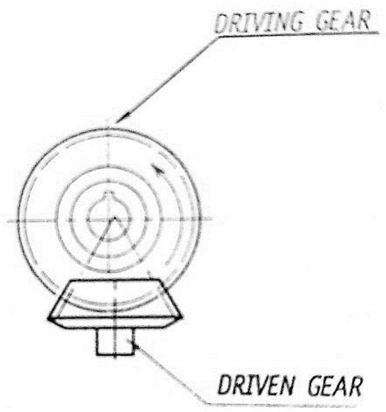
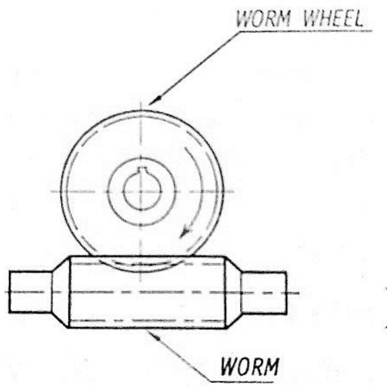
3. Bevel gears



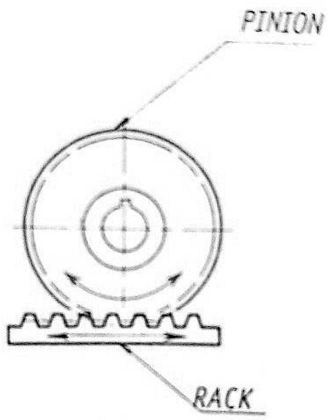
- When the axes of the two shafts are inclined to one another, and interest when produced, bevel gears shown in Fig. 4.
- Teeth of the bevel gears are cut on the conical surfaces.
- The most common examples of power transmission by bevel gears are those in which the axes of two shafts are at right angles to each other.
- When two bevel gears have their axes at right angles and are of equal sizes, they are called miter gears.

4. Worm and Worm Wheel



- Worm gears are used to transmit power between the driving and driven shafts having their axes at right angles and non-coplanar as shown in fig. 4.
- A worm drive consists of a worm (essentially a screw) which may have one or more number of helical threads of trapezoidal shape cut on it and a worm wheel ---a gear wheel with the tooth profile consisting of a small segment of a helix which engages with the worm.
- Worm gears are suitable for transmission of power when a high velocity ratio as high as 60:1 is required.
- They are generally employed in machine tools, like lathe, milling, drilling machines etc. to get large speed reduction.
- Another important characteristic of the worm and worm wheel drive is that it offers itself locking facility between the driven and the driving units when the direction of the drive is reversed.

5. Rack and Pinion



- When a rotary motion is to be converted into a linear motion, rack and pinion arrangement is used.
- Rack is a rectangular bar with a series of straight teeth cut on it as shown in fig.5.
- Theoretically rack is considered to be a spur gear of infinite diameter.
- Rack and pinion arrangement finds their application in machine tools,

such as, lathe, drilling, planning machines, and on some steep rail tracks.

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- Where the teeth of the locomotive wheel mesh with a rack embedded in the ground, offering the locomotive improved traction.

Velocity Ratio of Gear Drives

The velocity ratio of a gear drive is defined as the ratio of the speed of the driven gear to the speed of the driving gear. Let d_1 and d_2 be the pitch circle diameters of the driving gear respectively. Let T_1 and T_2 be the number of teeth on the driving and driven gears respectively. Let N_1 and N_2 be their speed in revolutions per minute.

Since there is no slip between the pitch cylinders of the two gear wheels, the linear speed of the two pitch cylinders must be equal.

$$\therefore \begin{bmatrix}\text{Linear Speed of the pitch cylinder} \\ \text{representing the Driving Gear}\end{bmatrix} = \begin{bmatrix}\text{Linear Speed of the pitch cylinder} \\ \text{representing the Driven Gear}\end{bmatrix}$$

i.e., $$\Pi d_1 N_1 = \Pi d_2 N_2$$

i.e., $$\frac{N_1}{N_2} = \frac{d_2}{d_1} \qquad \text{Equ}^n.\ (1)$$

The circular pitch for both the meshing gears remains same.

i.e., $$p_c = \frac{\Pi d_1}{T_1} = \frac{\Pi d_2}{T_2}$$

i.e., $$\frac{d_2}{d_1} = \frac{T_2}{T_1} \qquad \text{Equ}^n.\ (2)$$

From equations 1 and 2,

$$\text{Velocity Ratio of a gear Drive} = \frac{N_1}{N_2} = \frac{d_2}{d_1} = \frac{T_2}{T_1} \qquad \text{Equ}^n.\ (3)$$

Velocity ratio of the worm and worm wheel is expressed as:

$$[Velocity\ Ratio] = \frac{RPM\ of\ the\ worm}{RPM\ of\ the\ Wormwheel} = \frac{Number\ of\ Teeth\ on\ Wormwheel}{Number\ of\ Teeth\ on\ the\ Worm}$$

MODULE – 5

ENGINEERING MATERIALS

Engineering materials and joining processes: Engineering Materials: Types and applications of Ferrous & Nonferrous metals and alloys, ceramics and polymers

Composites: Introduction: Definition, Classification and applications (Air craft and Automobiles)

Introduction:

materials are various kinds are developed and it is difficult to describe all of them in a single text. Here, it is confined to study of those materials which are commonly used for various engineering applications. These materials have also a set of properties which are used for specific applications. Selections of materials for specific project/applications is an important activity for success and failure of that project.

Metals :-A metals a material that is typically hard, opaque, shiny, and features good electrical and thermal conductivity. Metals are generally malleable: they can be hammered or pressed permanently out of shape without breaking or cracking well as fusible and ductile Metals can be either ferrous or non-ferrous. Ferrous metals contain iron while non-ferrous metals do not both ferrous and non-ferrous metals are divided into pure metals and alloys.

A pure metal is an element – Ex: iron, copper, gold- unalloyed (not mixed) with another substance.

An alloy is a mixture of two or more elements (Ex: iron and carbon) to make another metal with particular properties (Ex: steel).

Classification and Selection of Materials:

The first module deals with the classification of the engineering materials and their processing techniques. The engineering materials can broadly be classified as:

a) Ferrous Metals

b) Non-ferrous Metals (aluminium, magnesium, copper, nickel, titanium)

c) Plastics (thermoplastics, thermosets)

d) Ceramics and Diamond

e) CompositeMaterials

Ferrous metals: - Ferrous metals contain iron. Examples are cast iron, mild steel, medium carbon steel, high carbon steel, stainless steel, and high speed steel.

Atomic number of iron is 26. Fe.

Non-ferrous metals: - Non-ferrous metals do not contain iron. Some common on-ferrous metals are aluminium, copper, zinc, tin, brass (copper + zinc), and bronze (copper + tin).

Type of Ferrous metal

Pig iron: - is the intermediate product of smelting iron ore with a high-carbon fuel such as coke, usually with limestone as a flux. It is the molten iron from the blast furnace, which is a large and cylinder-shaped furnace charged with iron ore, coke, and limestone. Charcoal and anthracite have also been used as fuel. Pig iron has a very high carbon content, typically 3.5– 4.5%, along with silica and other constituents of dross, which makes it very brittle and not useful directly as a material except for limited applications.

Wrought iron: - is an iron alloy with a very low carbon (less than 0.08%) content in contrast to cast iron (2.1% to 4%), and has fibrous inclusions known as slag up to 2% by weight. It is a semi-fused mass of iron with slag inclusions which gives it a "grain" resembling wood that is visible when it is etched or bent to the point of failure. Wrought iron is tough, malleable, ductile, corrosion-resistant and easily welded. Before the development of effective methods of steelmaking and the availability of large quantites of steel, wrought iron was the most common form of malleable iron.

Cast iron;- Composition Alloy of iron and 2-5% carbon, 1-3% silicon and traces of magnesium, sulphur and phosphorus

Cast iron is iron or a ferrous alloy which has been heated until it liquefies, and is then poured into a mould to solidify. It is usually made from pig iron. The alloy constituents affect its colour when fractured: white cast iron has carbide impurities which allow cracks to pass straight through. Grey cast iron has graphite flakes which deflect a passing crack and initiate countless new cracks as the material breaks. Carbon (C) and silicon (Si) are the main alloying elements, with the amount ranging from 2.1–4 wt. % and 1–3 wt. %, respectively. Iron alloys with less carbon content are known as steel. While this technically makes these base alloys ternary Fe–C–Si alloys, the principle of cast iron solidification is understood from the binary iron–carbon phase diagram. Since the compositions of most cast irons are around the eutectic point of the iron–carbon system, the melting temperatures closely correlate, usually ranging from 1,150 to 1,200 °C (2,100 to 2,190 °F), which is about 300 °C (572 °F) lower than the melting point of pure iron.

Properties and characteristics: -Hard skin, softer underneath, but brittle. It corrodes by rusting.

Application: -Parts with complex shapes which can be made by casting

Gray iron, or **grey cast iron**:-is a type of cast iron that has a graphitic microstructure. It is named after the gray colour of the fracture it forms, which is due to the presence of graphite. It is the most common cast iron and the most widely used cast material based on weight.

Application:-automotive engine blocks, gears, flywheels, frames.

White cast iron displays white fractured surface due to the presence of cementite. With a lower silicon content (graphitizing agent) and faster cooling rate, the carbon in *white cast iron* precipitates out of the melt as the metastable phase cementite, Fe_3C, rather than graphite.

Composition:-1.8 to 3.6%carbon, 0.5to2.0%silicon. Along with sulphur.

Application: - car wheels, sprockets, rolling mills rolls.

Malleable iron starts as a white iron casting that is then heat treated at about 900 °C (1,650 °F). Graphite separates out much more slowly in this case, so that tension has time to form it into spheroidal particles rather than flakes.

Composition: -2.0 to 3.0%carbon, 0.6 to 1.3%silicon. Along with sulphur.

Applications: - universal joints, yokes, differential gears, compressors, crankshaft and flanges.

Mild steel: - Composition: -Alloy of iron and 0.15 - 0.3% carbon, Properties and characteristics: -Tough, ductile and malleable. Good tensile strength, poor resistance to corrosion

Application: -General-purpose engineering material.

Steels: - are alloys of iron and carbon, widely used in construction and other applications because of their high tensile strengths and low costs. Carbon, other elements, and inclusions within iron act as hardening agents that prevent the movement of dislocations that otherwise occur in the crystal lattices of iron atoms.

The carbon in typical steel alloys may contribute up to 2.1% of its weight. Varying the amount of alloying elements, their formation in the steel either as solute elements, or as precipitated phases, retards the movement of those dislocations that make iron so ductile and weak, or thus controls qualities such as the hardness, ductility, and tensile strength of the resulting steel. Steel's strength compared to pure iron is only possible at the expense of ductility, of which iron has an excess.

Low carbon steel: - 0.05-0.1% carbon content**.**

Application: -valves, small gears, screws, rivets, nuts, pins etc...

Medium carbon steel; - Composition: -Alloy of iron and 0.35 - 0.7% carbon

Properties and characteristics: -Strong, hard and tough, with a high tensile strength, but less ductile than mild steel.

Application: -springs; any application where resistance to wear is needed

High carbon steel; - Composition: -Alloy of iron and carbon: 0.7 - 1.5% carbon

Properties and characteristics: -Even harder than medium carbon steel, and more brittle. Can be heat-treated to make it harder and tougher

Application: -Cutting tools, mechanical elements

Stainless steel:-Composition: -Alloy of iron and carbon with 16-26% chromium, 8-22% nickel and 8% magnesium

Properties and characteristics: -Hard and tough, resists wear and corrosion Application: -Cutlery, kitchen equipment

High speed steel:-Composition: -Alloy of iron and 0.35 - 0.7% carbon (medium carbon steel) with tungsten, chromium, vanadium, and sometimes cobalt

Properties and characteristics: -Very hard, high abrasion- and heat resistance Application: -Cutting tools for machines

Type of Non Ferrous metal

Aluminium: - Aluminium (or **aluminium**; see spelling differences) is a chemical element in the boron group with symbol **Al** and atomic number 13. It is a silvery white, soft, nonmagnetic, ductile metal. Aluminium is the third most abundant element (after oxygen and silicon), and the most abundant metal in the Earth's crust. It makes up about 8% by weight of the Earth's solid surface.

Composition: -Pure aluminium (an element)

Properties and characteristics: -Good strength-to-weight ratio, light, soft, ductile, good conductor of heat and electricity

Application Kitchen equipment, window frames, general cast components

Copper: - **Copper** is a chemical element with symbol **Cu** (from Latin: *cuprum*) and atomic number 29. It is a ductile metal with very high thermal and electrical conductivity. Pure copper is soft and malleable; a freshly exposed surface has a reddish-orange colour. It is used as a conductor of heat and electricity, a building material, and a constituent of various metal alloys.

Composition: -Pure copper (an element), Properties and characteristics: -Malleable and ductile, good conductor of heat and electricity, resistant to corrosion

Application Water pipes, electrical wire, decorative goods

Zinc: - Zinc, in commerce also *spelter*, is a chemical element with symbol **Zn** and atomic number 30. It is the first element of group 12 of the periodic table. In some respects zinc is chemically similar to magnesium: its ion is of similar size and its only common oxidation state is +2. Zinc is the 24th most abundant element in Earth's crust and has five stable isotopes.

Composition: -Pure zinc (an element), Properties and characteristics: -Weak metal, extremely resistant to corrosion

Application; - Usually used for coating steel to make galvanised items

Brass: - Brass is an alloy made of copper and zinc; the proportions of zinc and copper can be varied to create a range of brasses with varying properties. It is a substitution: atoms of the two constituents may replace each other within the same crystal structure.

Composition: -Alloy of copper and zinc, Properties and characteristics: - Resistant to corrosion, fairly hard, good conductor of heat and electricity

Application; - Cast items such as water taps, ornaments

Bronze:- Bronze is an alloy consisting primarily of copper and the addition of other metals (usually tin) and sometimes arsenic, phosphorus, aluminium, manganese, and silicon. These additions produces an alloy much harder than copper alone. The historical period where the archaeological record contains many bronze artifacts is known as the Bronze Age.

Composition: -Alloy of copper and tin, Properties and characteristics: -Fairly strong, malleable and ductile when soft

Application; - Decorative goods, architectural fittings

Tin: - Tin is a chemical element with the symbol **Sn** (for Latin: *stannum*) and atomic number 50. It is a main group metal in group 14 of the periodic table. Tin shows a chemical similarity to both neighbouring group-14 elements, germanium and lead, and has two possible oxidation states, +2 and the slightly more stable +4.

Composition: -Pure tin (an element), Properties and characteristics: -Soft, weak, malleable, ductile and resistant to corrosion

Application; - Usually used for coating steel to form tinplate

Polymers

Polymers are materials that consist of molecules formed by long chains of repeating units. They may be natural or synthetic. Many useful engineering materials are polymers, such as plastics, rubbers, fibers, adhesives, and coatings. Polymers are classified as thermoplastic polymers, thermosetting polymers (thermosets), and elastomers.

Thermoplastic Polymers:

Classification of thermoplastics and thermosets is based on their response to heat. If heat is applied to a thermoplastic, it will soften and melt. Once it is cooled, it will return to solid form. Thermoplastics do not experience any chemical change through repeated heating and

cooling (unless the temperature is high enough to break the molecular bonds). They are therefore very well suited to injection molding.

Thermosetting Polymers:

Thermosets are typically heated during initial processing, after which they become permanently hard. Thermosets will not melt upon reheating. If the applied heat becomes extreme however, the thermoset will degrade due to breaking of the molecular bonds. Thermosets typically have greater hardness and strength than thermoplastics. They also typically have better dimensional stability than thermoplastics, meaning that they are better at maintaining their original dimensions when subjected to temperature and moisture changes.

Elastomers:

Elastomers are highly elastic polymers with mechanical properties similar to rubber. Elastomers are commonly used for seals, adhesives, hoses, belts, and other flexible parts. The strength and stiffness of rubber can be increased through a process called vulcanization, which involves adding sulfur and subjecting the material to high temperature and pressure. This process causes cross-links to form between the polymer chains.

Ceramics:

Ceramics are solid compounds that may consist of metallic or non-metallic elements. The primary classifications of ceramics include glass, cement, clay products, refractories, and abrasives. Ceramics generally have excellent corrosion and wear resistance, high melting temperature, high stiffness, and low electrical and thermal conductivity. Ceramics are also very brittle materials.

Glass: Glasses are common materials and are seen in applications including windows, lenses, and containers. Glasses are amorphous, whereas the other ceramics are mainly crystalline. Primary advantages of glasses include transparency and ease of fabrication. The base element of most glasses is silica, and other components can be added to modify its properties. Common processes used to form glass include:

- heating until melting, then pouring into molds to cast into useful shapes
- heating until soft, then rolling
- heating until soft, then blowing into desired shapes

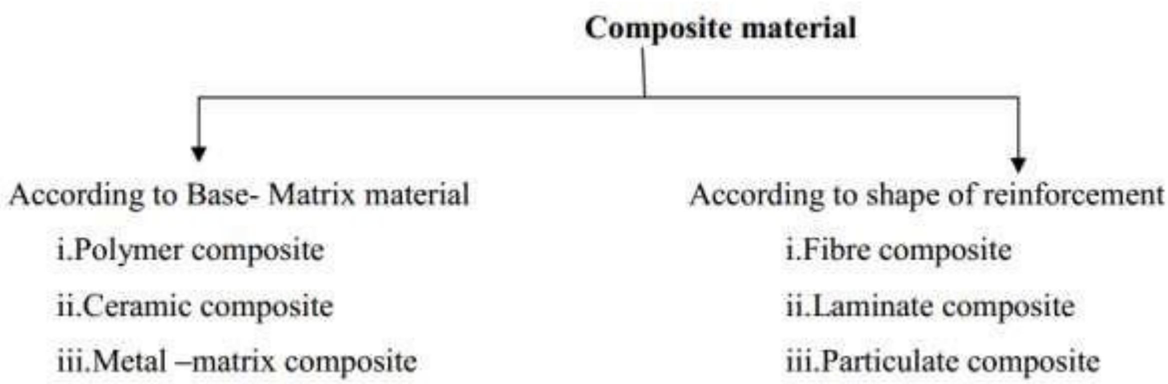
Composites

Definition of Composite Materials

A composite is combination of two materials in on a Macroscopic level and are not soluble in each other in which one of the materials, called the reinforcing phase, is in the form of Fibres, sheets, or particles, and is embedded in the other materials called the matrix phase.

The reinforcing material and the matrix material can be metal, ceramic, or polymer. Composites typically have a Fibre or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. The matrix acts as a load transfer medium between Fibres, and in less ideal cases where the loads are complex, the matrix may even have to bear loads transverse to the Fibre axis. The matrix also serves to protect the Fibres from environmental damage before, during and after composite processing. When designed properly, the new combined material exhibits better strength than would each individual material. Composites are used not only for their structural properties, but also for electrical, thermal, tribological and environmental applications

Classification of composite material



I. Polymer composite: - It consists of polymer resin as the matrix material. The term resin is used in this context to denote a high molecular weight re-enforcing plastic. These material are used as matrix material in great diversity of composite application, as well as in large quantities because of their excellent room temp properties, ease of fabrication, highly economical costs. Thermoplastic polymer and thermosetting polymers are used extensively as matrix material.

Thermoplastic are soften when heated and hardened when cooled. Processes are totally reversible. **Thermosetting** are become permanently hard when heated and do not soften upon subsequent heating.

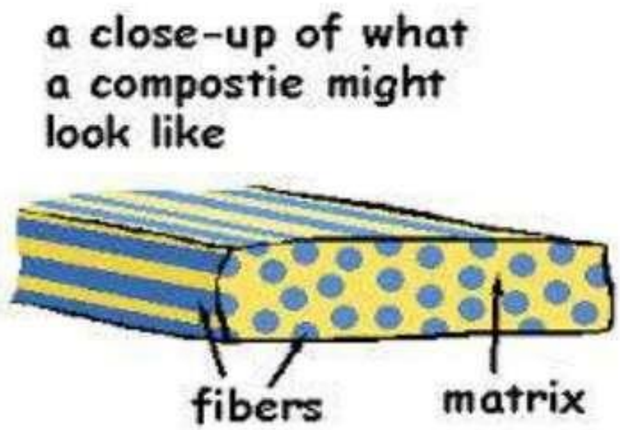
II. Ceramics composite:- Ceramics materials are very well known for their high temp properties as well as their resistance to oxidation. But they are very brittle which limits their application. Ceramics which are commonly used as matrix material are silicon nitride, silicon carbide, alumina, zirconium dioxide but it is fact that ceramics make better reinforcement material than matrix material.

III. Metal- matrix composite: - Metal matrixes composite are those where metal or alloys are used as matrix material. Metals used are usually ductile in nature and reinforced with strong and low density material of all shapes-fibres, whiskers and particulate. Such combination helps in obtaining materials with improved stiffness, abrasion resistance, creep resistance, thermal conductivity and dimensional stability. Some of the advantages of

metal matrix composite over polymer-matrix composite include higher operating temperature, non-flammability and greater resistance to degradation by original fluids. But MMC's are more expensive.

Ia). Fibre reinforced composite:- Fibre reinforced composite are those where the reinforcement in form of fibre. A natural example for fibre reinforce composite is wood in which strong cellulose fibre are aligned in a base matrix of lignin which bind the fibres. A Fibre is characterized by its length being much greater compared to its cross- sectional dimensions. The dimensions of the reinforcement determine its capability of contributing its properties to the composite.

Technologically the most important type of composites is fibre reinforced ones because of their wide range of application. The characteristics of fibre reinforced composite are expressed in terms of specific strength and specific modulus parameters. Specific strength is nothing but the ratio of tensile strength to specific gravity whereas specific modulus is the ratio of young's modulus to specific gravity. Fibre reinforced composites with exceptionally high specific strength and moduli have been successfully produced using fibres of different material.



ii. Laminated composites:-fibre –reinforced composites, if the fibres are of uniform alignment, the composites show anisotropic properties i.e., different properties along different direction. But if layers of such composites are stacked and bonded together in such a way that successive layers have their fibres aligned in different direction, the composite on the whole will have high strength and uniform properties in all direction.

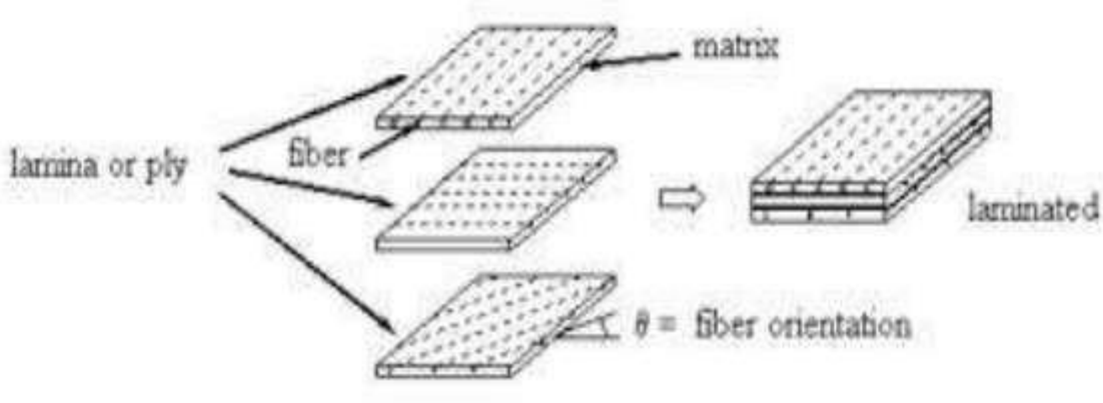
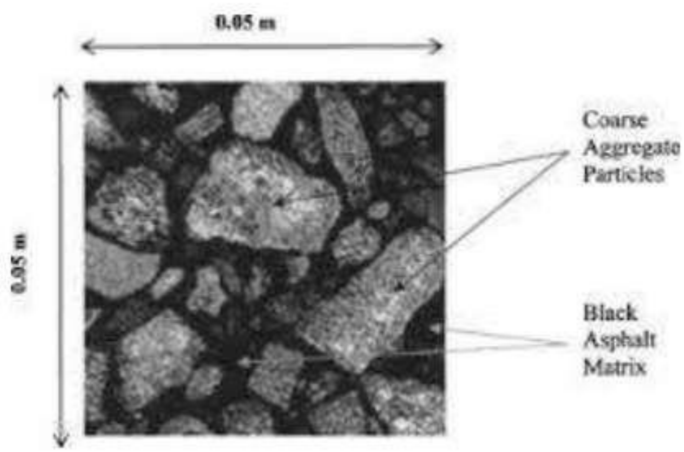


Figure 1 Laminated composite materials

The best example for a laminated for laminated composites is plywood where successive layers of wood having different orientation of grains are cemented together and composite on the whole has better strength in all direction.

Particulate composites In particulate composites the reinforcement is of particle nature. It may be spherical, cubic, tetragonal, a platelet, or of other regular or irregular shape. In this type of composites, particles of varying shape and size of one material is dispersed in a matrix of second material. Particulate composites are similar in construction to dispersion strengthened alloys but differ in particle size and percentage by volume.



Application of composite material Fibre reinforced composites

I. Fibre glass which is a composite consisting of glass fibres within a polymer matrix is extensively used to make pipe, roofing's, storage container, industrial floorings, automotive and marine bodies.

II. Carbon reinforced polymer composites are widely utilized in making sports and recreational equipment, pressure vessels, aircraft structural components.

III. Boron fibre reinforced polymer composite have been used in military air craft components, helicopter rotor blades and some sporting goods

IV. Silicon carbides and alumina fibre reinforced composites are utilized in tennis rackets, circuit boards and nose cone.

V. Filament winded fibre reinforced plastics which have extremely high tensile strengths are used to make chemical and fuel storage tanks, pressure vessels.

VI. Hybrid composite which is obtained by using two or more different kind of fibres in a single matrix. They have a better all-around combination of properties than composites containing only a single fibre type. A polymer composite reinforced with both carbon and glass fibre is used in sporting goods and light weight orthopaedic component.

Ceramics composites

A. Concrete which contains steel rods in a matrix of cement, sand and crushed stones is extensively used in construction.

B. Silicon carbide particles reinforced in titanium-di-boride matrix has good wear and corrosion resistance and hence can be used to produce heat exchangers.

Metal-Matrix composites

2) Boron fibre reinforced aluminium alloy matrix composite is used as a material to make some structural members in space shuttles owing to its very high strength to weight ratio.

3) Particulate alumina reinforced in aluminium matrix finds application in producing sporting