GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

Course Tittle: _____Utilization Of Electrical Energy_____

Following documents are available in Course File.

S.No.	Points	Yes	No
1	Institute and Department Vision and Mission Statements	√	
2	PEO & PO Mapping	√	
3	Academic Calendar	√	
4	Subject Allocation Sheet	√	
5	Class Time Table, Individual Timetable (Single Sheet)	√	
6	Syllabus Copy	√	
7	Course Handout	√	
8	CO-PO Mapping	√	
9	CO-Cognitive Level Mapping	√	
10	Lecture Notes	√	
11	Tutorial Sheets With Solution	√	
12	Soft Copy of Notes/Ppt/Slides	√	
13	Sessional Question Paper and Scheme of Evaluation	√	
14	Best, Average and Weak Answer Scripts for Each Sessional Exam. (Photocopies)	√	
15	Assignment Questions and Solutions	√	
16	Previous University Question Papers	√	
17	Result Analysis	√	
18	Feedback From Students	√	
19	Course Exit Survey		√
20	CO Attainment for All Mids.	√	
21	Remedial Action.		√

Course Instructor / Course Coordinator (Name)

Course Instructor / Course Coordinator (Signature)

Vision of the Institute

To be among the best of the institutions for engineers and technologists with attitudes, skills and knowledge and to become an epicentre of creative solutions.

Mission of the Institute

To achieve and impart quality education with an emphasis on practical skills and social relevance.

Vision of the Department

To impart technical knowledge and skills required to succeed in life, career and help society to achieve self sufficiency.

Mission of the Department

- To become an internationally leading department for higher learning.
- To build upon the culture and values of universal science and contemporary education.
- To be a centre of research and education generating knowledge and technologies which lay groundwork in shaping the future in the fields of electrical and
- electronics engineering.
- To develop partnership with industrial, R&D and government agencies and actively participate in conferences, technical and community activities.

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

Programme Educational Objectives (B.Tech. – EEE)

This programme is meant to prepare our students to professionally thrive and to lead.

During their progression:

Graduates will be able to

PEO 1: Have a successful technical or professional careers, including supportive and leadership roles on multidisciplinary teams.

PEO 2: Acquire, use and develop skills as required for effective professional practices.

PEO 3: Able to attain holistic education that is an essential prerequisite for being a responsible member of society.

PEO 4: Engage in life-long learning, to remain abreast in their profession and be leaders in our technologically vibrant society.

Programme Outcomes (B.Tech. – EEE)

At the end of the Programme, a graduate will have the ability to

PO 1: Apply knowledge of mathematics, science, and engineering.

PO 2: Design and conduct experiments, as well as to analyze and interpret data.

PO 3: Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO 4: Function on multi-disciplinary teams.

PO 5: Identify, formulates, and solves engineering problems.

PO 6: Understanding of professional and ethical responsibility.

PO 7: Communicate effectively.

PO 8: Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO 9: Recognition of the need for, and an ability to engage in life-long learning.

PO 10: Knowledge of contemporary issues.

PO 11: Utilize experimental, statistical and computational methods and tools necessary for engineering practice.

PO 12: Demonstrate an ability to design electrical and electronic circuits, power electronics, power systems; electrical machines analyze and interpret data and also an ability to design digital and analog systems and programming them.

PEOs & POs Mapping

Programme Educational Objectives (PEOs)	Programme Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	M	M	-	-	H	-	-	H	H	-	H	H
2	-	-	M	M	H	H	H	-	-	-	-	H
3	-	-	-	-	H	H	M	M	M	M	H	H
4	-	-	-	M	M	H	M	H	H	-	M	H

* H: Strongly Correlating (3); M: Moderately Correlating (2)& L: Weakly Correlating (1)

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

GRIET/DAA/1H/G/18-19 05 May 2018

ACADEMIC CALENDAR
Academic Year 2018-19

III B.TECH – FIRST SEMESTER

S. No.	EVENT	PERIOD	DURATION
1	1st Spell of Instructions	02-07-2018 to 01-09-2018	9 Weeks
2	1st Mid-term Examinations	03-09-2018 to 05-09-2018	3 Days
3	2nd Spell of Instructions	06-09-2018 to 24-10-2018	7 Weeks
4	2nd Mid-term Examinations	25-10-2018 to 27-10-2018	3 Days
5	Preparation	29-10-2018 to 06-11-2018	1 Week 3 Days
6	**End Semester Examinations (Theory/ Practicals) Regular/Supplementary**	**08-11-2018 to 08-12-2018**	**4 Weeks 3 Days**
7	Commencement of Second Semester, A.Y 2018-19	10-12-2018	

III B.TECH – SECOND SEMESTER

S. No.	EVENT	PERIOD	DURATION
1	1st Spell of Instruction	10-12-2018 to 02-02-2019	8 Weeks
2	1st Mid-term Examinations	04-02-2019 to 06-02-2019	3 Days
3	2nd Spell of Instruction	07-02-2019 to 06-04-2019	**8 Weeks 3 Days**
4	2nd Mid-term Examinations	08-04-2019 to 10-04-2019	3 Days
5	Preparation	11-04-2019 to 17-04-2019	1 Week
6	**End Semester Examinations (Theory/ Practicals) Regular**	18-04-2019 to 08-05-2019	3 Weeks
7	**Supplementary and Summer Vacation**	**09-05-2019 to 22-06-2019**	**6 Weeks 3 Days**
8	Commencement of First Semester, A.Y 2019-20	24-06-2019	

Copy to Director, Principal, Vice Principal, DOA, DOE, Balaji Kumar, DCGC, All HODs

(Dr. K. Anuradha)
Dean of Academic Affairs

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SUBJECT ALLOCATION SHEET

2018-19 II sem Subject Allocation sheet

GRIET/EEE/05B/G/18-19 **30.10.18**

II YEAR(GR17)	Section-A	Section-B
Managerial Economics and Financial Analysis		
Power Generation and Distrubution	SN	SN
AC Machines	VVSM	VVSM
Control Systems	Dr DGP	MS
Princeples of Digital Electronics	PRK	PRK
AC Machines Lab	PPK/DSR	PPK/DSR
Control Systems Lab	MS/PSVD	MS/PSVD
Analog and Digital Electronics Lab	RAK/DKK	RAK/DKK
Value Education and Ethics		
Gender Sensitization Lab	MS/PSVD	MS/PSVD
III YEAR (GR15)		
Computer Methods in Power systems	VVRR/MP	VVRR/MP
Switch Gear & Protection	PSVD	Dr JSD
Management Science		
Utilization of Electrical Energy	MRE	MRE
Non Conventional Sources of Energy		
Neural and Fuzzy Systems		
Sensors&Transducers	UVL	UVL
Power Systems Lab	GSR/YSV	GSR/YSV
Advanced English Communications Skills Lab		
Industry Oriented Mini Project Lab	PPK/AVK/Dr JP	MP/Dr JP
IV YEAR (GR15)		
Programmable Logic Controllers	PK	
Flexible AC Transmission Systems	Dr TSK	
EHV AC Transmission		
Power System Automation		
Modern Power Electronics	AVK	
DSP Based Electromechanical Systems		
Advaced Control Systems		
Programmable Logic Controllers-Lab	VVSM	PK
Main Projects	RAK/Dr SVJK	PK/VVRR

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

CLASS
TIME TABLE

GRIET/PRIN/06/G/01/18-19
BTech - EEE - B

Wef : 10 Dec 2018
III year - II Semester

DAY/ HOUR	9:00 - 9:45	9:45 - 10:30	10:30 - 11:15	11:15-12:00	12:00-12:30	12:30 - 1:20	1:20 - 2:10	2:10 - 3:00
MONDAY	PS Lab(B1) /AECS Lab(B2)				BREAK	UEE	CMPS	
TUESDAY	PS Lab(B2) /IOMP Lab(B1)					CMPS	S&T	
WEDNESDAY	IOMP Lab(B2) / AECS Lab(B1)					SGP	CMPS	
THURSDAY	SGP		UEE			S&T	MS	
FRIDAY	UEE		CMPS			S&T	SGP	
SATURDAY	MS		SGP			UEE	S&T	

Room No	
Theory	4404
Lab	4504/4407/

Class Incharge:	M Rekha

Subject Code	Subject Name	Faculty Code	Faculty name	Almanac	
CMPS	Computer Methods in Power systems	VVRR/MP	V Vijaya Rama Raju/M Prashanth	1st Spell of Instructions	10-12-2018 to 06-02-2019
SGP	Switch Gear & Protection	DrJSD	Dr J Sridevi	1st Mid-term Examinations	07-02-2019 to 09-02-2019
MS	Management Science	Dr MSRS	Dr M S R Sesha giri	2nd Spell of Instructions	11-02-2019 to 03-04-2019
UEE	Utilization of Electrical Energy	MRE	M Rekha	2nd Mid-term Examinations	04-04-2019 to 06-04-2019
S&T	Sensors&Transducers	UVL	U Vijaya Lakshmi	Preparation	08-04-2019 to 17-04-2019
PS Lab	Power Systems Lab	GSR/YSV	G Sandhya Rani/Y Satyavani	End Semester Examinations (Theory/ Practicals) Regular	18-04-2019 to 08-05-2019
AECS Lab	Advanced English Communications Skills Lab	ES	E Sailaja		
IOMP Lab	Industry Oriented Mini Project Lab	MP/Dr JP	M Prashanth/ Dr J Praveen	Supplementary and Summer Vacation	09-05-2019-to 22-06-2019
				Commencement of Second Semester , AY	24/06/2019

GRIET/PRIN/06/G/01/18-19
BTech - EEE - A

Wef : 10 Dec 2018

III year - II Semester

DAY/ HOUR	9:00 - 9:45	9:45 - 10:30	10:30 - 11:15	11:15-12:00	12:00-12:30	12:30 - 1:20	1:20 - 2:10	2:10 - 3:00
MONDAY	SGP		CMPS		BREAK	S&T		UEE
TUESDAY	SGP		S&T			UEE		CMPS
WEDNESDAY	MS		UEE			SGP		S&T
THURSDAY	IOMP Lab(A1) / AECS Lab(A2)					CMPS		S&T
FRIDAY	PS Lab(A2) /AECS Lab(A1)					MS		UEE
SATURDAY	IOMP Lab(A2) / PS Lab (A1)					CMPS		SGP

Room No	
Theory	4501
Lab	4504/4407/

Class Incharge:	M Rekha

Subject Code	Subject Name	Faculty Code	Faculty name	Almanac	

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

CMPS	Computer Methods in Power systems	VVRR/MP	V Vijaya Rama Raju/M Prashanth	1st Spell of Instructions	10-12-2018 to 06-02-2019
SGP	Switch Gear & Protection	PSVD	P Srividya Devi	1st Mid-term Examinations	07-02-2019 to 09-02-2019
MS	Management Science	Dr MSRS	Dr M S R Sesha giri	2nd Spell of Instructions	11-02-2019 to 03-04-2019
UEE	Utilization of Electrical Energy	MRE	M Rekha	2nd Mid-term Examinations	04-04-2019 to 06-04-2019
S&T	Sensors&Transducers	UVL	U Vijaya Lakshmi	Preparation	08-04-2019 to 17-04-2019
PS Lab	Power Systems Lab	GSR/YSV	G Sandhya Rani/Y Satyavani	End Semester Examinations (Theory/ Practicals) Regular	18-04-2019 to 08-05-2019
AECS Lab	Advanced English Communications Skills Lab	ES	E Sailaja		
IOMP Lab	Industry Oriented Mini Project Lab	AVK/PPK/Dr JP	A Vinay Kumar/P Praveen Kumar/ Dr J Praveen	Supplementary and Summer Vacation	09-05-2019-to 22-06-2019
				Commencement of Second Semester , AY	24/06/2019

UTILIZATION OF ELECTRICAL ENERGY (Professional Elective – II)

Course Code: **GR15A3023** L T P C
III Year II Sem 3 1 0 4

UNIT I
ELECTRIC DRIVES
Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

UNIT II
ELECTRIC HEATING
Advantages and methods of electric heating, resistance heating induction heating and dielectric heating .
ELECTRIC WELDING Electric welding, resistance and arc welding , electric welding equipment, comparison between A.C and D.C Welding.

UNIT III
ILLUMINATION
Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light., Various Illumination Methods: Discharge lamps, MV and SV lamps, comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of street lighting and flood lighting.

UNIT IV
ELECTRIC TRACTION – I
System of electric traction and track electrification, Review of existing electric traction systems in India, Special features of traction motor, methods of electric braking, plugging rheostatic braking and regenerative braking., Mechanics of train movement, Speed-time curves for different services, trapezoidal and quadrilateral speed time curves.

UNIT V
ELECTRIC TRACTION-II
Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesion.

TEXT BOOKS:
1)J.B.Gupta ,Utilization of Electric Power & Electric Traction
2) Partab,Art & Science of Utilization of Electrical Energy Dhanpat Rai & Sons

REFERENCES
1) N.V.Suryanarayana, Utilization of Electric Power including Electrical Drives & Electric Traction, New Age International(P) Limited, Publishers,1996.
2) C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International(P) Limited, Publishers, 1997.

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

COURSE SCHEDULE

Academic **Y**ear : **2018-2019**

Semester : **II**

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: ..**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

The Schedule for the whole Course / Subject is:

S. No.	Description	Total No. Of Periods
1.	Electric Drives	16
2.	Electric Heating and Electric Welding	12
3.	Illumination	16
4.	Electric Traction-I	14
5.	Electric Traction-II	08

Total No. of Instructional periods available for the course: ..……66……. Hours / Periods

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SCHEDULE OF INSTRUCTIONS
COURSE PLAN

Academic **Y**ear : **2018-2019**

Semester : **II**

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: ..**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

Unit No.	Lesson No.	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) Page Nos.: ____to ____
1	1	2	Types of Electric Drives and choice of motor	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:6
	2	2	Starting and Running Characteristics of DC motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:20
	3	2	Starting and Running Characteristics of AC Motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:26
	4	2	Speed control of DC Motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:75
	5	2	Speed control of AC Motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:82
	6	2	Temperature Rise	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:126
	7	2	Types Of Industrial loads-Continuous , Intermittent and variable loads	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:8
	8	2	Particular applications Of electric drives and Load Equalization	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:144
2	1	2	Advantages and Methods Of Electric heating-Resistance heating,	Obj:1,2,3, Out:4	J.B.Gupta, Pg:243
	2	2	Induction heating dielectric heating	Obj:1,2,3, Out:4	J.B.Gupta, Pg:263
	3	2	Dielectric heating	Obj:1,2,3, Out:4	J.B.Gupta, Pg:271

	4	2	Electric welding-Resistance welding-types and applications	Obj:1,2,3, Out:4	J.B.Gupta, Pg:282
	5	2	Types of Arc welding and applications	Obj:1,2,3, Out:4	J.B.Gupta, Pg: 291
	6	2	Comparision between AC and DC welding	Obj:1,2,3, Out:4	J.B.Gupta, Pg:307
3	1	2	Introduction and terms used in illumination	Obj:1,2,3 Out:7	J.B.Gupta, Pg:311
	2	2	Laws Of Illumination ,Polar Curves	Obj:1,2,3, Out:7	J.B.Gupta, Pg:316,322
	3	2	Photometry ,Various types of photometric heads	Obj:1,2,3, Out:7	J.B.Gupta, Pg:323
	4	2	Sources of light,Comparision between tungsten and filament lamps	Obj:1,2,3, Out:7	J.B.Gupta, Pg:327,341
	5	2	Filament lamps ,Florescent lamps	Obj:1,2,3, Out:7	J.B.Gupta, Pg:328
	6	2	MV and SV Lamps	Obj:1,2,3, Out:7	J.B.Gupta, Pg:331
	7	2	Basic Principles Of Light control,Types and design of lightning	Obj:1,2,3, Out:7	J.B.Gupta, Pg:344
	8	2	Street lighting and Flood lightning	Obj:1,2,3, Out:5,7	J.B.Gupta, Pg:353,354
4	1	2	Track Electrification , Existing Electric traction in India	Obj:1,2 Out:1,2	J.B.Gupta, Pg:420
	2		Systems Of Electric Traction	Obj:1,2 Out:1,2	J.B.Gupta, Pg:417
	3	2	Special Features Of Electric Traction motors	Obj:1,2 Out:1,2	J.B.Gupta, Pg:459
	4	2	Methods Of Electric braking, plugging ,rheostatic and regenerative braking	Obj:1,2 Out:1,2	J.B.Gupta, Pg:95
	5	2	Mechanism of train movement	Obj:1,2 Out:1,2,3	J.B.Gupta, Pg:436
	6	2	Speed time curves of different services, Trapezoidal speed time curve	Obj:1,2 Out:1,2,3	J.B.Gupta, Pg:430
	7	2	Quadrilateral speed time curve	Obj:1,2 Out:1,2,3	J.B.Gupta, Pg:432
5	1	2	Calculation of Tractive effort	Obj:1,2 Out:1,3,6	J.B.Gupta, Pg:437
	2	2	Specific energy consumption for a given run	Obj:1,2 Out:1,3,6	J.B.Gupta, Pg:444
	3	2	Effect Of Varying acceleration and retardation	Obj:1,2 Out:1,3,6	J.B.Gupta, Pg:444
	4	2	Adhesive weight and coefficient Of adhesion	Obj:1,2 Out:1,3,6	J.B.Gupta, Pg:451

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : **2018-2019**

Semester : **II** UNIT NO.: ……**I**…….

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: ..**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

Lesson No.	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…)
1	2	Types of Electric Drives and choice of motor	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:6
2	2	Starting and Running Characteristics of DC motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:20
3	2	Starting and Running Characteristics of AC Motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:26
4	2	Speed control of DC Motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:75
5		Speed control of AC Motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:82
6	2	Temperature Rise	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:126
7	2	Types Of Industrial loads- Continuous , Intermittent and variable loads	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:8
8	2	Particular applications Of electric drives and Load Equalization	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:144

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : **2018-2019**

Semester : **II** UNIT NO.: ……**II**…….

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: ..**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

Lesson No.	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) ___
1	2	Advantages and Methods Of Electric heating-Resistance heating,	Obj:1,2,3, Out:4	Utilization Of Electrical Energy J.B.Gupta, Pg:243
2	2	Induction heating dielectric heating	Obj:1,2,3, Out:4	Utilization Of Electrical Energy J.B.Gupta, Pg:263
3	2	Dielectric heating	Obj:1,2,3, Out:4	Utilization Of Electrical Energy J.B.Gupta, Pg:271
4	2	Electric welding-Resistance welding-types and applications	Obj:1,2,3, Out:4	Utilization Of Electrical Energy J.B.Gupta, Pg:282
5	2	Types of Arc welding and applications	Obj:1,2,3, Out:4	Utilization Of Electrical Energy J.B.Gupta, Pg: 291
6	2	Comparision between AC and DC welding	Obj:1,2,3, Out:4	Utilization Of Electrical Energy J.B.Gupta, Pg:307

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : **2018-2019**

Semester : **II** UNIT NO.: ……III…….

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: ..**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

Lesson No.	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) ___
1	2	Introduction and terms used in illumination	Obj:1,2,3 Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:311
2	2	Laws Of Illumination ,Polar Curves	Obj:1,2,3, Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:316,322
3	2	Photometry ,Various types of photometric heads	Obj:1,2,3, Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:323
4	2	Sources of light,Comparision between tungsten and filament lamps	Obj:1,2,3, Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:327,341
5	2	Filament lamps ,Florescent lamps	Obj:1,2,3, Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:328
6	2	MV and SV Lamps	Obj:1,2,3, Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:331
7	2	Basic Principles Of Light control,Types and design of lightning	Obj:1,2,3, Out:7	Utilization Of Electrical Energy J.B.Gupta, Pg:344
8	2	Street lighting and Flood lightning	Obj:1,2,3, Out:5,7	Utilization Of Electrical Energy J.B.Gupta, Pg:353,354

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : **2018-2019**

Semester : **II** UNIT NO.: ……**IV**…….

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: ..**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

Lesson No.	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) ___
1	2	Track Electrification , Existing Electric traction in India	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:420
2		Systems Of Electric Traction	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:417
3	2	Special Features Of Electric Traction motors	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:459
4	2	Methods Of Electric braking, plugging ,rheostatic and regenerative braking	Obj:1,2 Out:1,2	Utilization Of Electrical Energy J.B.Gupta, Pg:95
5	2	Mechanism of train movement	Obj:1,2 Out:1,2,3	Utilization Of Electrical Energy J.B.Gupta, Pg:436
6	2	Speed time curves of different services, Trapezoidal speed time curve	Obj:1,2 Out:1,2,3	Utilization Of Electrical Energy J.B.Gupta, Pg:430
7	2	Quadrilateral speed time curve	Obj:1,2 Out:1,2,3	Utilization Of Electrical Energy J.B.Gupta, Pg:432

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

SCHEDULE OF INSTRUCTIONS
UNIT PLAN

Academic **Y**ear : **2018-2019**

Semester : **II** UNIT NO.: ……**V**…….

Name of the Program: **B.Tech** ……..…**Electrical**……..… Year: ……**III**……. Section: A&B

Course/Subject: …**Utilization of Electrical Energy**…Course Code: .**GR15A3023..**

Name of the Faculty: …**M.Rekha**……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

Lesson No.	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Text Book, Journal…) ___
1	2	Calculation of Tractive effort	Obj:1,2 Out:1,3,6	Utilization Of Electrical Energy J.B.Gupta, Pg:437
2	2	Specific energy consumption for a given run	Obj:1,2 Out:1,3,6	Utilization Of Electrical Energy J.B.Gupta, Pg:444
3	2	Effect Of Varying acceleration and retardation	Obj:1,2 Out:1,3,6	Utilization Of Electrical Energy J.B.Gupta, Pg:444
4	2	Adhesive weight and coefficient Of adhesion	Obj:1,2 Out:1,3,6	Utilization Of Electrical Energy J.B.Gupta, Pg:451

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Department of Electrical & Electronics Engineering

LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: ……1,2&3…….Duration of Lesson: . 90min……

Lesson Title: Types of drives and Operating Characteristics

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Know the various types of electrical drives
2. Starting and running Characteristics of DC Motors
3. Starting and running Characteristics of AC Motors

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Introduction to Electric drives
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about various types of drives with applications. (Obj;- 1,2Out;- 1,2)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: ……4,5,6…….Duration of Lesson: …….... 90min……

Lesson Title: Speed control of AC and DC motors& Types of Industrial loads

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Speed control of DC and AC motors

2. Temperature rise

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Re collecting the contents of previous class.
- 90 min.: Speed control of AC and DC motors and different types of industrial loads.
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about the temperature rise. (Obj;- 1,2Out;-1,2)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: ……7&8…….Duration of Lesson: …….. 90min……

Lesson Title: Speed control of AC and DC motors& Types of Industrial loads

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Types Of Industrial loads

2. Load Equalization

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Re collecting the contents of previous class.
- 90 min.: Load equalization and types of industrial loads
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about the different types of industrial loads. (Obj;- 1,2 Out;-1,2)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: 9,10,11…….Duration of Lesson: …….. 90min……

Lesson Title: Electric heating

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Different methods of electric heating

2. Explain about Resistance, Induction and Dielectric heating

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Re collecting the contents of previous class.
- 90 min.: Electric Heating
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about the different types of Electric heating. (Obj;- 1,2,3 Out;-4)

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Department of Electrical & Electronics Engineering

LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: ….12,13,14…… .Duration of Lesson: …….. 90min……

Lesson Title: Electric Welding

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Different methods of electric welding

2. Explain about Resistance and Arc welding

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Electric Welding
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about the different types of Electric welding. (Obj;- 1,2,3 Out;-4)

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Department of Electrical & Electronics Engineering

LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: ……..15,16&17…….Duration of Lesson: …….... 90min……

Lesson Title: Illumination

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1. Explain about laws of Illumination
2. Different terms used in illumination
3. Explain about different photometric heads

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Re collecting the contents of previous class.
- 90 min.: Introduction to Illumination & terms used in Illumination.
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about the laws of Illumination. (Obj;- 1,2,3 Out;-5,7)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..18,19&20…….Duration of Lesson: …….. 90min……

Lesson Title: Terms used in Illumination

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

2. Explain about different sources Of Light.
4. Explain about tungsten and filament lamps.
5. Explain about florescent and gaseous discharge lamps.

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Different types of lamps.
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about the laws of Illumination. (Obj;- 1,2,3 Out;-5,7)

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Department of Electrical & Electronics Engineering

LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..21,22&23…….Duration of Lesson: …….. 90min……

Lesson Title: Different Types Of lamps

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

3. Explain about different sources Of Light.
6. Explain about tungsten and filament lamps.
7. Explain about florescent and gaseous discharge lamps.

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Different types of lamps.
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about different types of lamps.. (Obj;- 1,2,3 Out;-5,7)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..24&25…….Duration of Lesson: …….. 90min……

Lesson Title: Street lighting and flood lighting

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Explain about basic principle of lighting
2.Discuss about Street lighting and flood lighting

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Street lighting and flood lighting
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about basic principles of lighting (Obj;- 1,2,3 Out;-5,7)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..26,27,28&29…….Duration of Lesson: …….... 90min……

Lesson Title: Systems of electric traction and track electrification

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Explain about different systems of traction
2.Discuss about track electrification

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Systems of electric traction and track electrification
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about Systems of electric traction and track electrification
(Obj;- 1,2,3 Out;-1,2)

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LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..30,31,32…….Duration of Lesson: …….... 90min……

Lesson Title: Speed time curves

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Explain about Mechanism of train movement
2.Discuss about Speed time curves

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Trapezoidal quadrilateral speed time curve
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about speed time curves (Obj;- 1,2,3 Out;-1,2,3)

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Department of Electrical & Electronics Engineering

LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..33,34…….Duration of Lesson: …….. 90min……

Lesson Title: Tractive effort

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Explain about tractive effort
2.Discuss about Specific energy consumption

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Tractive effort and specific energy consumption
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Explain about Specific energy consumption (Obj;- 1,2,3 Out;-1,,3, 6)

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Department of Electrical & Electronics Engineering

LESSON PLAN

Academic **Y**ear : 2018-2019

Semester : **II**

Name of the Program: B.Tech .**Electrical**… Year: ……**III**..……. Section: A&B

Course/Subject: **Utilization Of Electrical Energy**

Name of the Faculty: ……**M.Rekha**…..……Dept.:…**EEE**…….

Designation : ASST.PROFESSOR

Lesson No: …..35,36…….Duration of Lesson: …….. 90min……

Lesson Title: Adhesive weight and coefficient of adhesion

INSTRUCTIONAL/LESSON OBJECTIVES:

On completion of this lesson the student shall be able to:

1.Discuss about effect of varying acceleration and retardation
2.Define adhesive weight and coefficient of adhesion

TEACHING AIDS : OHP PROJECTOR, WHITEBOARD, MARKER, DUSTER.
TEACHING POINTS :

- 5 min.: Taking attendance
- 15 min.: Recollecting the contents of previous class.
- 90 min.: Tractive effort and specific energy consumption
- 10min.: Doubts clarification and Review of the class.

Assignment / Questions: Discuss about effect of varying acceleration and retardation (Obj;- 1,2,3 Out;-1,,3, 6)

GOKARAJU RANGARAJU
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Department of Electrical & Electronics Engineering

ASSIGNMENT SHEET – 1

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M. Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Assignment corresponds to Unit No. / Lesson ……**1**…….

Q1. Enumerate the advantages and disadvantages associated with electric drives?

.

Q2. Draw heating and cooling curves of a given motor?

Q3. Compare the speed-torque characteristics of compound motor

Objective Nos.: …… 1,2…….

Outcome Nos.: ……1,2…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

ASSIGNMENT SHEET – 2

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Assignment corresponds to Unit No. / Lesson ……**2**…….

Q1. Explain the Principle of dielectric heating and applications

Q2. What are different methods of heat transfer? Explain in brief.

Q3. Compare resistance and arc welding?

.

Objective Nos.: …… 1,2,3…….

Outcome Nos.: ……4…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

ASSIGNMENT SHEET – 3

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Assignment corresponds to Unit No. / Lesson ……**3**…….

Q1. Determine the effective illumination of a room 12m x 15m, illuminated by 15 lamps of 200 watts each. The luminous efficiency of each lamp is given as 12 lumens /watt. Given coefficient of utilization as 0.4. Let D.F. =0.8 and waste light factor = 1.2.

Objective Nos.: …… 1,2,3…….

Outcome Nos.: ……5,7…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

ASSIGNMENT SHEET – 4

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Assignment corresponds to Unit No. / Lesson ……**4**…….

Q1. What are the advantages and disadvantages of track electrification.

Q2. Draw the speed-time curve of a main line service and explain.

Q3. . For a quadrilateral speed-time curve of an electric train, derive expression for the distance between stops and speed at the end of the coasting period.

Objective Nos.: …… 1,2…….

Outcome Nos.: ……1,2,3…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

ASSIGNMENT SHEET – 5

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Assignment corresponds to Unit No. / Lesson ……**5**…….

Q1. Derive an expression for tractive effort for a train on a level track.

Q2. Define specific energy output and specific energy consumption.

Q3. Derive an expression for specific energy output on level track using a simplified speed-time curve. What purpose is achieved by this quantity?

Objective Nos.: …… 1,2…….

Outcome Nos.: ……1,3, 6…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

TUTORIAL SHEET – 1

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M. Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Tutorial corresponds to Unit No. / Lesson ……**1**…….

Q1. A 250V d.c. shunt motor drives a load whose torque remains constant. The motor takes a current of 22.5A from the supply and its speed is 400 rpm. If the speed is to be raised to 600 rpm, what additional resistance must be placed in the shunt field circuit? Shunt field resistance is 100 Ω and armature resistance is 0.5Ω.

.

Q2. A Motor Works on 2 mints load cycle constituted as follows:
0 to 15 sec. load rising from 0 to 1050 h.p., 15 to 85 sec. constant load of 600 h.p., 85 to 95 sec. Regenerative braking with the h.p returned falling uniformly from 200 to 0 h.p., 95 to 120 sec. Motor is at rest. Determine the continuous rating of the motor that would be suitable for the load Cycle. Assume the rating to depend upon the (i) r.m.s value of the loading (ii) average value of Loading.

Objective Nos.: …… 1,2…….

Outcome Nos.: ……1,2…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

TUTORIAL SHEET – 2

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Tutorial corresponds to Unit No. / Lesson ……**2**…….

Q1 Six resistances each of 40 ohms are used as heating elements in furnace. Find the power of the furnace for various connections to a three phase 230V supply.

Q2. A 20KW single phase 230V resistance oven employs a circular Nichrome wire for its heating element. If the wire temperature is not to exceed 1170^0 C and temperature of charge to be 500^0 C, calculate diameter and length of the wire. Take K=0.57, e=0.95 and ρ=1.09 micro ohm-m. What would be the temperature of the element when the charge is cold?

Objective Nos.: …… 1,2,3…….

Outcome Nos.: ……4…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

TUTORIAL SHEET – 3

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Tutorial corresponds to Unit No. / Lesson ……**3**…….

Q1. Determine the effective illumination of a room 12m x 15m, illuminated by 15 lamps of 200 watts each. The luminous efficiency of each lamp is given as 12 lumens /watt. Given coefficient of utilization as 0.4. Let D.F. =0.8 and waste light factor = 1.2.Q2. Write a short notes on Bunsen photometer head.

Objective Nos.: …… 1,2,3…….

Outcome Nos.: ……5,7…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

TUTORIAL SHEET – 4

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Tutorial corresponds to Unit No. / Lesson ……**4**…….

Q1 A train is to be run between two stations 5kms apart at an average speed of 50km/hr. If the maximum speed is to be limited to 70km/hr, acceleration to 2km/hr/sec, braking retardation to 4km/hr/sec and coasting retardation to 0.1km/hr/sec, determine the speed at the end of coasting, duration of coasting period and braking period.

Q2. A train runs with average speed of 40 kmph, Distance between stations is 2 Km, Values of acceleration and retardation are 1.5 Kmphps and 2.5 Kmphps respectively. Find the maximum speed of train assuming trapezoidal speed time curve.

Objective Nos.: …… 1,2…….

Outcome Nos.: ……1,2,3…….

Signature of HOD

Date:

Signature of faculty

Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

TUTORIAL SHEET – 5

Academic **Y**ear : 2018-2019

Semester : I

Name of the Program: B.Tech ……**Electrical**……..… Year: ……**III**…….. Section: A&B

Course/Subject: …**Utilization Of Electrical energy**…Course Code: ..**GR15A3023**.

Name of the Faculty: ……**M.Rekha** ……..……..Dept.: …**EEE**……

Designation: ASST.PROFESSOR

This Tutorial corresponds to Unit No. / Lesson ……**5**…….

Q1. Calculate the specific energy consumption if a maximum speed of 12.2 m/s and for a given run of 1,525 meters an acceleration of 0.366 m/s^2 are desired. Train resistance during acceleration is 52.6 Newtons/1000 kg and during coasting is 6.12 newtons/1000 kg, 10% being allowable for rotational inertia. The efficiency of the equipment during the acceleration period is 50%. Assume a quadrilateral speed- time curve.

Q2. An elective train has an average speed of 45kmph on a level track between stops 1800m apart. It is accelerated at 2 kmphps and braked at 3 kmphps. Draw the speed time curve for the run. Estimate the energy consumption at the axles of the train per tonne – km. Take train resistance constant at 45 N per tonne and allow 10 % for rotational inertia.

Objective Nos.: …… 1,2…….

Outcome Nos.: ……1,3,6…….

Signature of HOD Signature of faculty

Date: Date:

COURSE OBJECTIVES

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

Academic **Y**ear :2018-19

Semester : **II**

Name of the Program: EEE…… Year:B.Tech III**……**..… Section:A/B

Course/Subject: ……Utilization of Electrical Energy…… CourseCode: **GR15A3023**

Name of the Faculty: M.Rekha Dept.EEE:……

Designation: ASST.PROFESSOR

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To provide the students the fundamental concepts of drives and types of drives used in traction.
2	To train the students with a good engineering breadth so as to analyze the accessing techniques for braking system implementation in traction.
3	To comprehend the different issues related to heating, welding and illumination.

Signature of HOD Signature of faculty

Date: Date:

Note: Please refer to Bloom's Taxonomy, to know objectives.

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Department of Electrical & Electronics Engineering

COURSE OUTCOMES

Academic **Y**ear :2018-19

Semester : **II**

Name of the Program:EEE…… Year:B.Tech III…….…. Section: A/B

Course/Subject: Utilization of Electrica Energy CourseCode: **GR15A3023**

Name of the Faculty: M.Rekha, Dept.: ……EEE……

Designation: ASST.PROFESSOR

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1	Underlying concepts of electrical traction drives
2	Introduction to different types of drives used in traction
3	A good engineering breadth so as to analyze different train movements time curves
4	Categorization of different types of Electrical heating and Electrical welding
5	Ability to discuss about street lightning and flood lightning.
6	Assessment of specific energy consumption of a train.
7	Skill to explain about the different types of Illumination

Signature of HOD Signature of faculty

Date: Date:

Note: Please Taxonomy, refer to know to the Bloom's illustrative verbs that can be used to state the outcomes.

CO-PO Mapping

Course Code	Course Title	Course Outcomes	Programme Outcomes										
			a	b	c	d	e	f	g	h	i	j	k	l
GR15A3023	UTILIZATION OF ELECTRICAL ENERGY	Underlying concepts of electrical traction drives	H	H	M	H	M	-	-	M	H	M	M	H
		Introduction to different types of drives used in traction	M	M	M	H		-	-	M	M	H	M	H
		A good engineering breadth so as to analyze different train movements time curves	H	H	M	H	M	M	-	M	M	H	M	H
		Categorization of different types of Electrical heating and Electrical welding	H	H	M	H	M	-	-	M	M	M	M	H
		Ability to discuss about street lightning and flood lightning.	H	M	H	H	M	-	-	M	-	M	H	M
		Assessment of specific energy consumption of a train.	H	M	M	H	M	M	-	M	-	M	M	-
		Skill to explain about the different types of Illumination	H	M	H	H	-	-	-	M	M	M	H	H

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Department of Electrical & Electronics Engineering

Academic Year: **2018-19**
Year: **III**
Semester: **II**

MID Exam –II (Descriptive)
UEE
Code: GR15A3023

Date: /04/2019
Duration: **90 min**
Max Marks: **15**

Note: Answer any three questions. All questions carry equal marks.

1.	Explain about the Sodium vapour discharge lamp	[5]	[CO-5]
2.	Define (a)MHCP (b) Utilization factor (c) MSCP (d)Illumination (e) Candle Power	[5]	[CO-7]
3.	Draw the Speed – Time curve of main line service and derive the expression for maximum speed.	[5]	[CO-3]
4.	An electric train has quadrilateral speed time curve as follows: (i)Uniform acceleration from rest at 2 kmphps for 30 seconds (ii)Coasting for 50 sec (iii)Braking period for 20 sec The train is moving a uniform down gradient of 1%,tractive resistance 40 newtons/tonne, rotational inertia effect 10% of dead weight, duration of stop 15 sec and overall efficiency of transmission gear and motor as 75%.Calculate its schedules speed and specific energy consumption.	[5]	[CO-6]

Academic Year: **2018-19**
Year: **III**
Semester: **II**

MID Exam – II(Objective)
UEE
Code: GR15A3023

Date: /04/2019
Duration: **30 min**
Max Marks: **05**

Roll No: | | | | | | | | | | |

Note: Answer all the questions. All questions carry equal marks.

1. The human eye responds better to [ ]
A. Infrared radiations B. Ultra-violet radiations C. Both as above D. None as above

2. Colour of light depends on [ ]
A. Wavelength B. Frequency C. Wavelength and frequency D. Amplitude

3. Tungsten filament lamp contains [ ]
A. Nitrogen B. Vacuum C. Oxygen D. Hydrogen

4. Auxiliary electrode for initiating ionisation is observed in [ ]
A. Sodium Vapour lamp B. Halogen Lamp C. High pressure mercury vapour lamp D. Fluorescent lamp

5.The weight of the train and the locomotive to be pulled is called as [ ]
A. Accelerating weight B. Dead weight C. Adhesive weight D. Coefficient of Adhesion

6. Flood lightning is not used for [ ]
A. Reading B. Aesthetic C. Advertising D. Industrial

7. As the acceleration or retardation increases the specific energy consumption [ ]
A. Increases B. Decreases C. No change D. None

8. The maximum speed attained by the train is known as [ ]
A. Crest Speed B. Average Speed C. Scheduled Speed D. All of the above
9. The effective force required to propel the train is called as [ ]
A. Power B. Energy C. Specific Energy D. Tractive effort
10. An electric train has an average speed of 42kmphps on a level track between stops 1400m apart.it is accelerated at 1.7kmphps and is braked at 3.3kmphps. Calculate the max.speed [ ]
A. 48kmph B. 50kmph C. 52kmph D. 54kmph

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

Academic Year: **2018-19**
Year: **III**
Semester: **II**

MID Exam –II (Descriptive)
UEE
Code: GR15A3023

Date: 08 /04/2019
Duration: **90 min**
Max Marks: **15**

Note: Answer any three questions. All questions carry equal marks.

1.	Explain about the Sodium vapour discharge lamp	[5]	[CO-5]
2.	Define (a)MHCP (b) Utilization factor (c) MSCP (d)Illumination (e) Candle Power	[5]	[CO-7]
3.	Draw the Speed – Time curve of main line service and derive the expression for maximum speed.	[5]	[CO-3]
4.	An electric train has quadrilateral speed time curve as follows: (i)Uniform acceleration from rest at 2 kmphps for 30 seconds (ii)Coasting for 50 sec (iii)Braking period for 20 sec The train is moving a uniform down gradient of 1%,tractive resistance 40 newtons/tonne, rotational inertia effect 10% of dead weight, duration of stop 15 sec and overall efficiency of transmission gear and motor as 75%.Calculate its schedules speed and specific energy consumption.	[5]	[CO-6]

Academic Year: **2018-19**
Year: **III**
Semester: **II**

MID Exam – II(Objective)
UEE
Code: GR15A3023

Date: 08 /04/2019
Duration: **30 min**
Max Marks: **05**

Roll No: | | | | | | | | | | |

Note: Answer all the questions. All questions carry equal marks.

1. The human eye responds better to [ ]
A. Infrared radiations B. Ultra-violet radiations C. Both as above D. None as above

2. Colour of light depends on [ ]
A. Wavelength B. Frequency C. Wavelength and frequency D. Amplitude

3. Tungsten filament lamp contains [ ]
A. Nitrogen B. Vacuum C. Oxygen D. Hydrogen

4. Auxiliary electrode for initiating ionisation is observed in [ ]
A. Sodium Vapour lamp B. Halogen Lamp C. High pressure mercury vapour lamp D. Fluorescent lamp

5.The weight of the train and the locomotive to be pulled is called as [ ]
A. Accelerating weight B. Dead weight C. Adhesive weight D. Coefficient of Adhesion

6. Flood lightning is not used for [ ]
A. Reading B. Aesthetic C. Advertising D. Industrial

7. As the acceleration or retardation increases the specific energy consumption [ ]
A. Increases B. Decreases C. No change D. None

8. The maximum speed attained by the train is known as [ ]
A. Crest Speed B. Average Speed C. Scheduled Speed D. All of the above

9. The effective force required to propel the train is called as [ ]
A. Power B. Energy C. Specific Energy D. Tractive effort

10. An electric train has an average speed of 42kmphps on a level track between stops 1400m apart.it is accelerated at 1.7kmphps and is braked at 3.3kmphps. Calculate the max.speed
[ ]
A. 48kmph B. 50kmph C. 52kmph D. 54kmph

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

CODE: GR14A3023	GR 14	SET - 1

III B. Tech II Semester Regular Examinations, May 2017
Utilization of Electrical Energy
(Electrical and Electronics Engineering)

Time: 3 hours **Max Marks: 70**

PART – A
Answer ALL questions. All questions carry equal marks.
*****

10 * 2 Marks = 20 Marks

1). a	State the advantages and disadvantages of Electric Drive over Mechanical Drive.	**[2]**
b	What are the conditions for stable operation of a Motor?	**[2]**
c	What are the causes of failure of Heating Elements?	**[2]**
d	Why alternating current is found most suitable for Resistance Welding?	**[2]**
e	What are the two Laws of Illumination?	**[2]**
f	Why sodium discharge lamps are not used for general lighting?	**[2]**
g	What are the factors affecting the schedule speed of a Train?	**[2]**
h	What are the merits and demerits of DC System of Track Electrification?	**[2]**
i	What do you understand by the specific energy consumption and what factors affect the same?	**[2]**
j	What are the requirements which an Ideal Braking System should possess?	**[2]**

PART – B
Answer any FIVE questions. All questions carry equal marks.
*****

5 * 10 Marks = 50 Marks

2.	a) Write down the various methods of controlling the speed of D.C motor, Explain the method of rheostatic control. b) Explain various types of Loads.	**[10]**
3.	State a few advantages of electric heating over other forms of heating and Describe the construction and working of any type of induction furnace.	**[10]**

4. Explain with the help of a circuit diagram the working of a fluorescent lamp, and what are the advantages of fluorescent lighting over plain mercury discharge lighting. **[10]**

5. a) Discuss various factors on which final choice of Traction System depends. **[10]**

b) A train runs with average speed of 40 kmph, Distance between stations is 2 Km, Values of acceleration and retardation are 1.5 Kmphps and 2.5 Kmphps respectively. Find the maximum speed of train assuming trapezoidal speed time curve.

6. An electric train weighing 300 tonnes runs 10%, up gradient with following speed time curve. **[10]**

i. Uniform acceleration of 1.5 Kmphps for 30 seconds
ii. Constant speed for 40 seconds
iii. Coasting for 30 seconds
iv. Braking at 2.5 Kmphps to reset

Calculate the specific energy consumption if tractive resistance is 45 N/tonne, rotational inertia effect 10%, overall efficiency of transmission and motor 75%.

7. i) What is the necessity of Starter in Induction Motor? **[3]**
ii) What is the difference between carbon arc welding and metallic arc welding? **[4]**
iii) Why Condenser is used in the Fluorescent Tube Circuit? **[3]**

8. a) State the merits and/or demerits of Electric Traction with reference to Electric Power crisis in India. **[10]**

b) Explain the terms, “Dead Weight”, “Effective Weight”, and “Adhesive Weight” in a Locomotive.

*****

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

CODE: GR11A3094	GR 11	SET - 4

III B. Tech II Semester Regular Examinations, May/June 2016
Utilization of Electrical Energy
(Electrical & Electronics Engineering)

Time: 3 hours **Max Marks: 75**

Answer any FIVE questions
All questions carry equal marks
*****

1). a	Explain what you mean by "Individual drive and Group drive". Discuss their relative merits and demerits.	**[8]**
b	Derive an expression for temperature rise of an Electrical Machine. State the assumptions made.	**[7]**
2). a	With a neat sketch explain the construction and principle of indirect core type induction furnace.	**[8]**
b	Explain resistance welding. What are the various methods of resistance welding? Describe any two of them.	**[7]**
3). a	Determine the effective illumination of a room 12m x 15m, illuminated by 15 lamps of 200 watts each. The luminous efficiency of each lamp is given as 12 lumens /watt. Given coefficient of utilization as 0.4. Let D.F. =0.8 and waste light factor = 1.2.	**[8]**
b	Explain with sketch the principle of working of a Sodium Vapor Lamp and enumerate its advantages and disadvantages as source of Light.	**[7]**
4). a	What is Kando System? Explain the potentialities of this system for its being adopted in future.	**[8]**
b	Draw the Speed – Time curve of main line service and explain.	**[7]**
5). a	Explain the terms : i) Co efficient of Adhesion ii) Adhesive Weight iii) Dead Weight iv) Acceleration Weight	**[8]**
b	Calculate the Adhesive Weight of a locomotive which accelerates up a gradient of 1 in 100 at 0.8 kmphps. The self-weight of locomotive is 350 Tonnes.	**[7]**

Coefficient of adhesion is 0.25. Assume a train resistance of 45 N-m/Tonne and allow 10% for the effect of rotational inertia.

6). a Write short notes on: **[8]**

i) Temperature rise in Electric Drives
ii) The Ajax-Wyatt Furnace

b What is the function of a **[7]**

(i) Starter and (ii) Choke Coil in a Fluorescent Lamp

7) a Write short notes on : **[8]**

i) Regenerative braking of Induction Motor.
ii) Why a d.c series motor is ideally suited for traction purposes.

b What do you understand by the following: **[7]**

i) Tractive effort for acceleration
ii) Tractive effort to overcome the resistance to the motion
iii) Total Tractive effort.

*****

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INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

GUIDELINES TO STUDY THE COURSE/SUBJECT

Academic **Y**ear :2018-19

Semester : II

Name of the Program: EEE**.**…. Year: B. Tech III**……** Section: A/B

Course/Subject: …Utilization of Electrical Energy Course Code: GR15A3023

Name of the Faculty: M. Rekha Dept.: ……EEE……

Designation: ASST.PROFESSOR
Guidelines to study the Course/ Subject: Utilization of Electrical Energy

Course Design and Delivery System (CDD):

The Course syllabus is written into number of learning objectives and outcomes.

These learning objectives and outcomes will be achieved through lectures, assessments, assignments, experiments in the laboratory, projects, seminars, presentations, etc.

Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.

The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

Understand the principles of Learning
Understand the psychology of students
Develop instructional objectives for a given topic
Prepare course, unit and lesson plans
Understand different methods of teaching and learning
Use appropriate teaching and learning aids
Plan and deliver lectures effectively
Provide feedback to students using various methods of Assessments and tools of Evaluation
Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD
Date:

Signature of faculty
Date:

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

EVALUATION STRATEGY

Academic **Y**ear :2018-19

Semester : III

Name of the Program: EEE…… Year: B.Tech III……..… Section: A/B

Course/Subject:Utilization of Electrical Energy
Course Code: GR14A3023

Name of the Faculty: M. Rekha Dept.: ……EEE……

Designation: ASST.PROFESSOR

1. TARGET:

A) Percentage for pass:40%

b) Percentage of class:85%

2. COURSE PLAN& CONTENT DELIVERY
(Please write how you intend to cover the contents: i.e., coverage of Units/Lessons by lectures, design, exercises, solving numerical problems, demonstration of models, model preparation, experiments in the Lab., or by assignments,etc.)

3. METHOD OF EVALUATION

3.1 ☐ Continuous Assessment Examinations (CAE-I, CAE-II)

3.2 ☐ Assignments/Seminars

3.3 ☐ Quiz

3.4 ☐ Semester/End Examination

4. List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this
Semester.

……..

Signature of HOD

Date:

Signature of faculty

Date:

Cognitive Level Mapping

COs	Cognitive Learning Levels					
	1	2	3	4	5	6
1		√				
2				√		
3			√			
4		√				
5		√				
6					√	
7						√

Cognitive Learning Levels

CLL 1: Remembering
CLL 2: Understanding
CLL 3: Applying
CLL 4: Analyzing
CLL 5: Evaluating
CLL 6: Creating

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Department of Electrical & Electronics Engineering

CO Attainments

III B.Tech-(UEE) II Sem I Mid Marks(2018-19) A-Sec

S.NO	1 (CO2)	2 (CO1)	3 (CO4)	4 (CO4)
15241A0243	2.5		2.5	
16241A0201				3
16241A0202	5	5	3.5	
16241A0203		4.5	5	4.5
16241A0205	4.5		4.5	1
16241A0206	1		4.5	4.5
16241A0207	4.5	5	2.5	
16241A0208		3.5	3.5	
16241A0209	5	5	2	
16241A0210	5		2	
16241A0211	5	2	2	
16241A0212	3			
16241A0213	4.5	1.5	3	
16241A0214	5		4	
16241A0216				
16241A0217	5	4	5	
16241A0218	5	3.5	2.5	
16241A0219	5	1		
16241A0220	4	3	1	
16241A0221	4.5	3.5	4	
16241A0222	4	2	3	
16241A0223	5	4.5	5	
16241A0224	4		4	
16241A0225	5	4.5	3.5	
16241A0226	5	4	5	
16241A0227	2		2	5
16241A0228	5	1	5	
16241A0229		2	2	
16241A0230	4.5	4.5	5	
16241A0231	5	1	5	
16241A0232				
16241A0233			4	
16241A0234	4	2	3.5	
16241A0235	5	1	4	
16241A0236	5	5	5	
16241A0237	1		5	
16241A0238		2	2	
16241A0239	5	2	4	
16241A0240	5	2	5	
16241A0241	5	2	5	
16241A0242	5		5	1
16241A0243	5		1	5
16241A0244	3.5	5	4.5	
16241A0245	5	2		3
16241A0246	5	2	5	

16241A0247	4.5		5	1.5
16241A0248	5		5	5
16241A0249	5	2	5	
16241A0250	3	4.5	1.5	
16241A0251		5		
16241A0252	5		5	4
16241A0253	4.5	1	3.5	
16241A0254	5	1	5	
16241A0255	5	1	4	
16241A0256	4.5		2.5	5
16241A0257	5	5	5	
16241A0258	5	1	5	
16241A0259	5	5	5	
16241A0260	5	1	5	
17245A0201	5	5	5	
17245A0202	5	4	1	
17245A0203	5	5	4	
17245A0204	5	5	2	
17245A0205	5	5	5	
17245A0206	5	3	2	
17245A0207	5	4	3	
17245A0208	5	3	4	
17245A0209	5	5	5	
17245A0210	5	3	5	
17245A0211	5	4	3	
17245A0212	5	5	5	
Total	283	167.5	244.5	42.5
No of students attempted(NSA)	62	52	64	12
Attempt %=(NSA/Total no of students)*100	87.32	73.24	90.14	16.90
Average (attainment)= Total/NSA	4.56	3.22	3.82	3.54
Attainment % = (Total/no.of max marks*no.of students attempted)*100	**91.29**	**64.42**	**76.41**	**70.83**
	1 C02	2 CO1	3 CO4	4 CO4

CO1	91.29
CO2	64.42
CO3	
CO4	73.62
CO5	
CO6	
CO7	

III B.Tech-(UEE) II Sem I Mid Marks(2018-19) B-sec

S.NO	1 (CO2)	2 (CO1)	3 (CO4)	4 (CO4)
16241A0261	5	4.5	2.5	
16241A0262	4.5	5	5	
16241A0263	5	1	3	
16241A0264	2			
16241A0265	3	1	2	
16241A0266	5		2	
16241A0267	5	5	5	
16241A0268	5	1.5	3.5	
16241A0269	5	5	4	
16241A0270	5	3	3	
16241A0271	5	2	4	
16241A0272	5	5	4	
16241A0273	3	1	3	
16241A0274	5	5	4	
16241A0275	4.5	3.5		4
16241A0276	5	5		
16241A0277	3	3	3	
16241A0278	5	5	4	
16241A0279	3	1	3	
16241A0280	4.5	4.5	5	
16241A0281	5	4	5	
16241A0282	5	4.5	3.5	
16241A0283	2	1		
16241A0284	5	2.5	3.5	
16241A0285	5	3	4	
16241A0286	5	5	4	
16241A0287	2	4	3	
16241A0288	5		3	
16241A0289	5	2	5	
16241A0290	5	5	5	
16241A0291	5	5	4	
16241A0292	5	5	4	
16241A0293	3.5	3.5	2	
16241A0294	4		2	
16241A0295	3	4	2	
16241A0296	5	2	5	
16241A0297	4	4.5	1.5	
16241A0298	3			
16241A0299	5	1	5	
16241A02A0	5		2	
16241A02A2	5	5	3	
16241A02A3	5	5	3	
16241A02A5	5	2	2	
16241A02A6	5	1	3	
16241A02A7	3		3	
16241A02A8	5	5	5	
16241A02A9	5	5	5	

16241A02B0	4.5	3.5		
16241A02B1	5	2	3	
16241A02B2	5	4	4	
16241A02B3	4.5		1.5	
16241A02B4	4	1	1	
16241A02B5	5	4	2	
16241A02B6	5	5	3	
16241A02B7	5	2.5	2.5	
16241A02B8	5	5	4	
16241A02B9	5	5	4	
17245A0213	5	1	2	
17245A0214	5	5	5	
17245A0215	5	4	1	
17245A0216	5	4.5	3.5	
17245A0217	5	4	1	
17245A0218	4	5	4	
17245A0219	5	4	1.5	
17245A0220	5	5	5	
17245A0221	5	5	5	
17245A0222	5	2	4	
17245A0223	4.5		2.5	
17245A0224	5	3	1	
18248A0201	5	5	5	
Total	318.5	219.5	213	4
No of students attempted(NSA)	70	61	64	1
Attempt %=(NSA/Total no of students)*100	98.59	85.92	90.14	1.41
Average (attainment)= Total/NSA	4.55	3.60	3.33	4.00
Attainment % = (Total/no.of max marks*no.of students attempted)*100	91.00	71.97	66.56	80.00
	1 (CO2)	**2 (CO1)**	**3 (CO4)**	**4 (CO4)**

CO1	71.97
CO2	91.00
CO3	
CO4	73.28
CO5	
CO6	
CO7	

Final Average values of A&B	CO1	81.63
	CO2	77.71
	CO3	
	CO4	73.45
	CO5	
	CO6	
	CO7	

III B.Tech-(UEE) II Sem II Mid Marks(2018-19) A-Sec

S.NO	1 (CO5)	2 (CO7)	3 (CO3)	4 (CO6)
15241A0243	4			
16241A0201		4	4	
16241A0202	4	5	5	
16241A0203	5	5		4
16241A0205	1	2	1	
16241A0206	1	3	0	
16241A0207		5	4	
16241A0208		3	1	
16241A0209		5	5	4
16241A0210	1	1		
16241A0211		5	4	
16241A0212	3	3		
16241A0213	2	2	2	
16241A0214		2	4	
16241A0216	1		2	
16241A0217	4	5	4	
16241A0218		1	2	1
16241A0219		2	4	
16241A0220			4	
16241A0221		4	5	
16241A0222	3		3	1
16241A0223	5	5	5	
16241A0224	2	1	4	
16241A0225		3	3	1
16241A0226		4	3	
16241A0227	5	1		1
16241A0228	3		1	
16241A0229	4		5	
16241A0230	1		5	
16241A0231	4	2	4	
16241A0232				
16241A0233	1		2	
16241A0234	5	4	4	
16241A0235	4		4	
16241A0236	5	4	5	
16241A0237	4		1	
16241A0238		2		
16241A0239		5	1	
16241A0240	5	5	4	
16241A0241	4	3	1	
16241A0242	2	2	1	
16241A0243	3	2	1	
16241A0244		0	2	1
16241A0245	1	2	0	
16241A0246	5	5	1	
16241A0247	1		2	

16241A0248	3	1		
16241A0249	2	2	0	
16241A0250		2	3	1
16241A0251			3	2
16241A0252	4	4	4	
16241A0253	2	1		
16241A0254	1	2		
16241A0255	4	2	1	
16241A0256	2	4	2	
16241A0257	4	4	1	
16241A0258		2	1	
16241A0259	5	5	5	
16241A0260	1	2		
17245A0201	5	5	5	
17245A0202			4	2
17245A0203	5	4	2	
17245A0204		3	4	
17245A0205	5	5	5	
17245A0206	4	5	4	
17245A0207		5	5	
17245A0208			3	4
17245A0209		4	5	4
17245A0210	5	4	5	
17245A0211	1	4	4	
17245A0212	5	5	4	
Total	151	182	183	26
No of students attempted(NSA)	47	56	60	12
Attempt %=(NSA/Total no of students)*100	66.20	78.87	84.51	16.90
Average (attainment)= Total/NSA	3.21	3.25	3.05	2.17
Attainment % = (Total/no.of max marks*no.of students attempted)*100	**64.26**	**65.00**	**61.00**	**43.33**
	1 (CO5)	**2 (CO7)**	**3 (CO3)**	**4 (CO6)**

CO1	
CO2	
CO3	61.00
CO4	
CO5	64.26
CO6	43.33
CO7	65.00

III B.Tech-(UEE) II Sem II Mid Marks(2018-19) B-Sec

S.NO	1 (CO5)	2 (CO7)	3 (CO3)	4 (CO6)
16241A0261	4	3		1
16241A0262	5	5		4
16241A0263	3	3	1	
16241A0264	1			
16241A0265	2			3
16241A0266	4	2		
16241A0267	3	3	3	
16241A0268	3	3		
16241A0269	3	4	5	5
16241A0270		4	3	
16241A0271	1	3	4	
16241A0272	5	5	5	
16241A0273	2	2		
16241A0274	5	5		4
16241A0275		1	2	2
16241A0276	5	2		
16241A0277				1
16241A0278	3	2	1	
16241A0279	2	2		
16241A0280	5	4	4	
16241A0281	5	4	4	2
16241A0282	5	4	5	
16241A0283	0	0		1
16241A0284	2	2	1	
16241A0285	4	2		
16241A0286	4	2		1
16241A0287		2	0	
16241A0288		3		
16241A0289	4	3	1	
16241A0290	5	4	5	
16241A0291	3	2		
16241A0292	3	0		1
16241A0293	3			
16241A0294	5	0	0	
16241A0295	2			
16241A0296	5	3	1	
16241A0297	5	2		
16241A0298	5			
16241A0299		2		
16241A02A0	2	1		
16241A02A2	4	2		1
16241A02A3	3	2	2	
16241A02A4	5	2		
16241A02A5	5	3		
16241A02A6	1	2		
16241A02A7	5	5		1

16241A02A8	5	5	5	4
16241A02A9	5	2	3	
16241A02B0	3	2	0	
16241A02B1	5	2	4	
16241A02B2	2	1	1	
16241A02B3	2	1		1
16241A02B4	5	3	2	
16241A02B5	3	1	4	
16241A02B6	5	3	1	
16241A02B7	5	5	4	
16241A02B8	3	5	1	
16241A02B9				
17245A0213		5	4	1
17245A0214	5	5	5	
17245A0215	5			
17245A0216	4	5	4	
17245A0217	5		1	
17245A0218	5	5	4	2
17245A0219	5	4	5	
17245A0220	5	4	5	1
17245A0221	5	5	5	0
17245A0222		5	5	2
17245A0223		5	4	
17245A0224	2	4	5	1
18248A0201				
Total	225	182	119	39
No of students attempted(NSA)	60	61	39	21
Attempt %=(NSA/Total no of students)*100	84.51	85.92	54.93	29.58
Average (attainment)= Total/NSA	3.75	2.98	3.05	1.86
Attainment % = (Total/no.of max marks*no.of students attempted)*100	75.00	59.67	61.03	37.14
	1 (CO5)	**2 (CO7)**	**3 (CO3)**	**4 (CO6)**

			Final Average values of A&B	
CO3	61.03		CO3	61
CO5	75.25		CO5	69.8
CO6	37.33		CO6	40.3
CO7	59.67		CO7	62.3

Result Analysis

Year	Total No. Of Students appeared	Total No. of Students Passed	No. of Students Failed	GRADE =10	GRADE= 9	GRADE=8	GRADE= 7	GRADE= 6	GRADE= 5	GRADE= 4	PASS PERCENTAGE(%)
2017-18	140	130	10	13	54	34	13	07	04	05	92.85
2016-17	124	122	02	31 (<60 %)	43 (60-70%)	48 (>70 %)					98.38
2015-16	140	128	12	61 (<60 %)	27 (60-70%)	40 (>70 %)					91.42

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Electrical & Electronics Engineering

FEEDBACK FROM STUDENTS

Gokaraju Rangaraju Institute of Engineering & Technology
(Autonomous)

Summation of Teacher Appraisal by Student
Academic Year 2018-19

Name of the Instructor	M Rekha
Faculty ID	933
Branch	EEE
Class and Semester/Section	III / II / A
Academic Year	2018-19
Subject Title	Utilization of Electrical Energy
Total No. of Responses/class strength	11/71

Average rating on a scale of 4 for the responses considered:

S. No	Questions of Feedback	Average
1	How do the teacher explain the subject?	3.1
2	The teacher pays attention to	3
3	The Language and communication skills of the teacher is	3.1
4	Is the session Interactive?	3.1
5	Rate your teacher's explanation in clearing the doubts	3.1
6	Rate your teacher's commitment in completing the syllabus	3.3
7	Rate your teacher's punctuality	3.3
8	Rate your teachers use of teaching aids	3.2
9	Rate your teacher's guidance in other activities like NPTEL, Moodle, Swayam, Projects.	3.2
10	What is your overall opinion about the teacher?	3

Net Feedback on a scale of 1 to 4: 3.14

Remarks by HOD:

(12 Pages)

Gokaraju Rangaraju Institute of Engineering & Technology

(Autonomous)

Bachupally, Kukatpally, Hyderabad - 500090

No. 255541

ROLL NO.:	1	6	2	4	1	A	0	2	0	5

CLASS & BRANCH EEE-A

NAME A.B Srija SUBJECT UEE

SIGNATURE OF THE INVIGILATOR DATE: 5/02/2019

SEMESTER	I	II

I	II

MID TERM EXAMINATION

Q.NO.	1		2		3		4		5		TOTAL
	a	b	a	b	a	b	a	b	a	b	
MARKS	4½				4½		1				10

START WRITING FROM HERE

There are 3 types of drives.

1. Group drives
2. Individual drives
3. Multi motor drives

- Group drives: These drives contains one electrical motor which drives many electrical machines. A single electrical motor controls many electrical machines. It contains a long shaft. It consists of spindle to which electrical quantities like pully or others cable can be attached. It is also called as lengthed.

1

$s = kT_m$

$\dot{m} = T_L - J.k \frac{dT_m}{dt}$

$\dot{m} = T_0 + T_f$

$\therefore - J.k \frac{dT_m}{dt} = T_0 + T_f$

$-T_f = T_0 + J.k \frac{dT_m}{dT}$

$\log (T_m - T_0) - \log (T_L - T_f) = \frac{1}{Jk} + C$

$\log \left(\frac{T_m - T_0}{T_L - T_f} \right) = \frac{1}{Jk} + C$

$\frac{T_m - T_0}{T_L - T_f} = e^{-Jk} + C$

$\therefore T_m - T_0 = e^{-Jk} (T_L - T_f)$

$\therefore T_m = T_0 + e^{-Jk} (T_L - T_f)$ //

3)

there are two types of Resistance welding they are

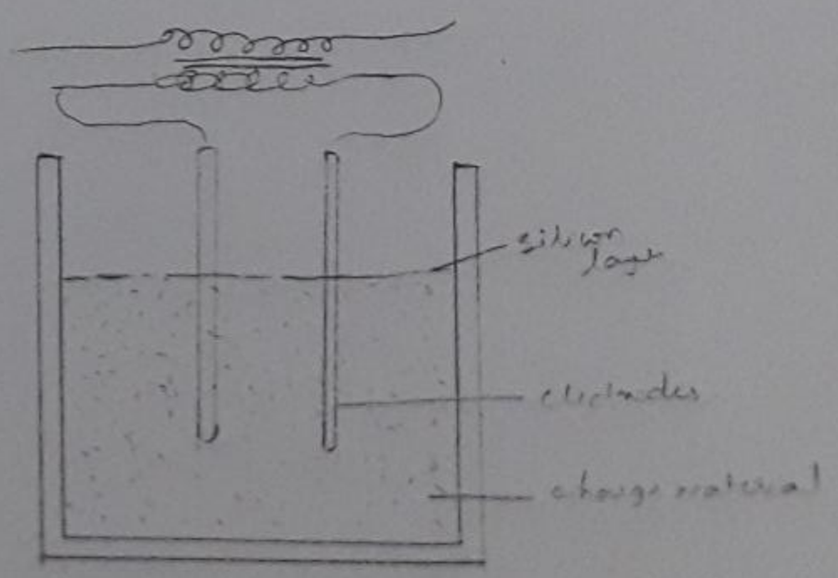
- direct resistance welding
- indirect Resistance welding.

- in direct Resistance type of welding the current is passed through the electrodes which is placed in the charge Medium

- due to the electrodes which are present in the charge large amount of heat is produced.

- a single layer of Silicon powder is dropped on the layer of charge to reduce the leakage of heat.

2



Gokaraju Rangaraju Institute of Engineering & Technology
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Bachupally, Kukatpally, Hyderabad - 500090

No. 255610

ROLL NO.:	1	6	2	4	1	A	0	2	9	0

CLASS & BRANCH III year and EEE-B

NAME M. Roopa SUBJECT Utilization of Electrical energy

SIGNATURE OF THE INVIGILATOR [signature] DATE: 5/2/19

SEMESTER	I	II ✓

I ✓	II

MID TERM EXAMINATION

Q.NO.	1		2		3		4		5		TOTAL
	a	b	a	b	a	b	a	b	a	b	
MARKS	5		5		5						15

M.Roopa

START WRITING FROM HERE

ectrical drives: =

It is defined as which is used to control the motor is called Electrical drives

Classified into 3-types

Group drives

Individual drives

multi motor drive

oup drives: =

Group drives means which consists of only one linear shaft motor (to the connected to the more number

cs:=

inance cost of group drives are less

initial cost is less compared to individual drives

mple: 100kW power required for the only one motor

st is less and 10kW power required using 10V

motors having more cost

: renewable and resoureable drive

bility characteristics are obtained in Group drive

load efficiency control system

de control operation is required for the group drive

is compactable and less place required.

power will easily flows one place to another

through the transmissions lines

is no-fuel required for the group drives

would be installed at any distant places

vantages:-

electrical supply is required. By the failure

electrical supply and the motor will stop working

machine will be damaged

individual drives:=

individual drives means which consists of only one machine

is connected to only one motor.

Advantages:=

1) It can be controlled easily without external supply

2) flexibility nature is required for the individual drives

3) individual drives are mainly used lifts, cranes etc

4) It is also having high load efficiency.

5) less skill workers required for the working purpose

dis Advantages:=

1) initial cost is more compared to group drives

2) if the one motor is stop it's working that mean if the motor is fail or damage then the system doesn't work for longer time

3) more skilled workers are required for the maintainance

4) it could n't placed at any where. It would be placed where the power supply is produced.

5) Power loss is more

$$\frac{q}{JK} \cdot dt = \frac{dT_m}{d(T_L - T_m)}$$

Integrating on b.s

$$\boxed{-\log[T_L - T_m] = \frac{q}{JK} t + c} \quad \text{---(1)}$$

the value of c assuming $t = 0$, $T_m = T_0$

$$\therefore c = -\log[T_L - T_0] \quad \text{sub in (1)}$$

$$-\log[T_L - T_m] \cdot \frac{q}{JK} t - \log[T_L - T_0]$$

$$-\frac{q}{JK} t = -\log[T_L - T_0] + \log[T_L - T_m]$$

$$-\frac{q}{JK} t = \log\left[\frac{T_L - T_m}{T_L - T_0}\right]$$

$$\Rightarrow e^{-q/JK\, t} = \left[\frac{T_L - T_m}{T_L - T_0}\right]$$

$$[T_L - T_0]\, e^{-q/JK\, t} = T_L - T_m$$

$$\Rightarrow \boxed{T_m = T_L - [T_L - T_0]\, e^{-q/JK\, t}}$$

) load decreasing

sing the load to the motor decreasing KE

$d\omega/dt$ remains negative

$$\boxed{T_E = -J/q \frac{d\omega}{dt}}$$

$$T_m = T_L + T_E$$

$$\boxed{T_m = T_{m'} + [T_L + T_0]\, e^{-q/JK\, t}}$$

$T_{m'}$ = is motor torque where load is decreasing

3) Resistance welding:=

Welding means joining the two metals by appling h

this heat is produced due to the when high curre

passing through the resistance. Hence it is know

Resistance weldings.

Various methods are three for Resistance weldin

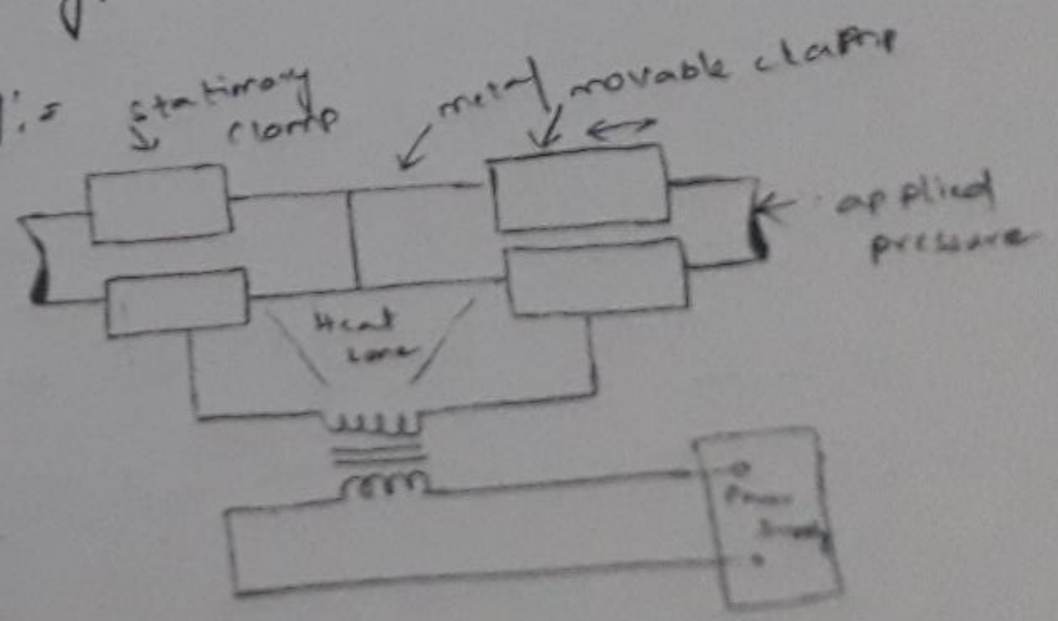
i) Butt welding

a) upset welding

b) Flash welding

ii) spot welding.

Upset welding:=



upset welding

...tted by the light source [illegible]

Utilisation factor (U.F) = $\frac{\text{flux [illegible] utilised by working [illegible]}}{\text{flux lumens illuminated by light source}}$

MSCP :- (Mean spherical candle power)

it is defined as the illumination at candle ... from a point of light source on a surface in all directions and in all planes.

$$MSCP = \frac{\text{Total flux (lumens)}}{4\pi} \text{ candle power}$$

...mination (E) :-

It is defined as the ratio of the luminous intensity and the square of the distance (Area) which the light is distributed on any surface and it is given by,

(a) Candle power (CP) :-

It is defined as the ratio of the lumens illuminated (emitted) from light source to the solid angle in which it is emitted. And it is given by,

$$\text{candle power} = \frac{\text{lumens}}{\text{solid angle (steradians)}}$$

3) Draw the Speed-Time Curve of main line service and derive the expression for maximum sp...

Answer :-

- Main line service
  - → Distance between stops - More than 10 km
  - → Acceleration - 0.6 to 0.8 kmph
  - → Retardation - 1.5 kmph
  - → More free running time and c...

:plain about the Sodium Vapour discharge lamp

Ans:-

- This lamp emits light (Flux lumens) through the discharge of sodium vapour.

- Inside this lamp it is filled with sodium Gas Vapour

It's efficiency of illumination is poor.

And the brightness level of lighting is more for sodium Vapour discharge lamp.

Therefore this is the Explanation of ium Vapour discharge lamp Required.

s is filled with vacuum

re sodium vapour discharge lamp should be placed

zontally to ensure that the sodium inside the dis

ge tube is spread out uniformly

re should be taken while replacing the inner bulb

use if sodium comes into contact with moisture then

breaks out.

; the sodium vapour discharge lamp works on A C

ply, a choke is provided to limit the current. The

sence of choke will reduce the power factor. Hence

capacitor is placed to increase the power fac

;

When the supply is not given to the sodium vapour disch

e lamp then the sodium will be in the solid state

will not vapourise.

ren the supply is given discharge takes place in the

n gas as a result energy will be released increasi

the temperature.

en discharge takes place in the neon gas red-~~org~~

ge light is emitted.

ren the temperature increases and the sodium gets

→ It will take about 10 minutes to obtain its full rated

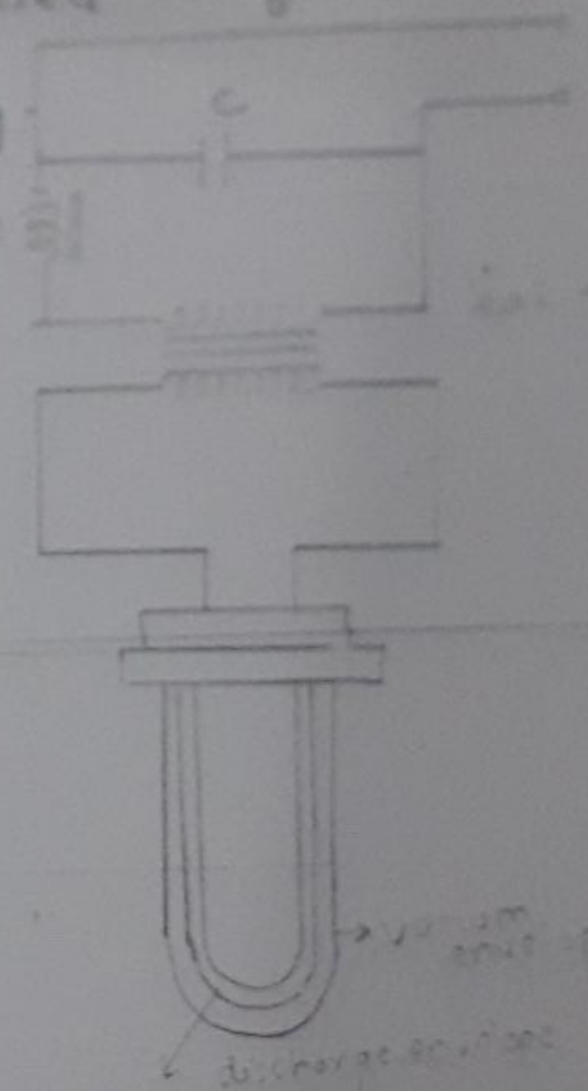
intensity

→ The efficiency of sodium vapour discharge lamp is

about 40 lumens/watt

→ These are used in general industrial lighting and

street lighting.



Sodium vapour discharge lamp

2(a) Mean horizontal candle power: (MHCP): It is defined

Mean the mean of the candle powers in all the dir

-ons in the horizontal plane containing the light

Sodium vapour lamp

in all the planes from the source of light.

Illumination: When light falls on a surface that enomenon is known as Illumination. Illumination is fined as the number of lumens falling on a surface unit area. It is denoted by 'E' and units are lux lumens/m^2.

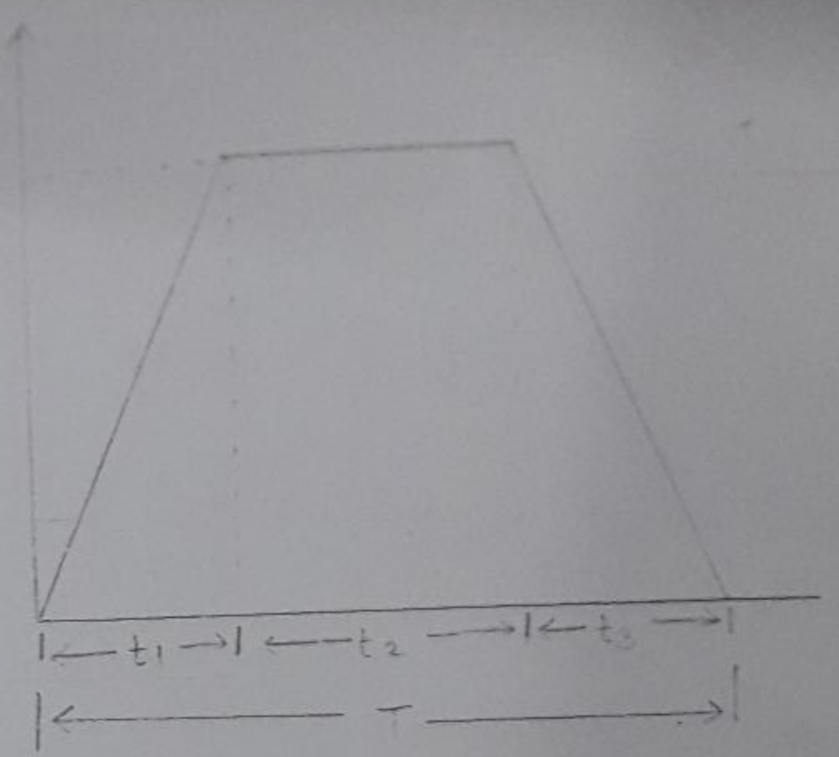
$$E = \frac{F}{A} \quad \text{lumens/m}^2 \text{ or lux}$$

mination is also defined as the luminous flux per unit

Candle power: Candle power is the light radiating capa- of a light source. Candle power is defined as the ber of lumens per unit solid angle. It is denoted by

Utilization factor: Utilization factor is defined as the of power output to the input power of a

3. Speed-Time curve of main line service



Let α = acceleration in kmphps

β = retardation in kmphps

V_m = crest speed of the train in kmph

T = Total time of the train.

where, t_1 = time taken for accelerating in secs

t_2 = time taken for free running period in secs

t_3 = time taken for retardation in sec

$$t_1 = \frac{V_m}{\alpha}, \quad t_3 = \frac{V_m}{\beta}, \quad t_2 = T - (t_1 + t_3) = T - \left(\frac{V_m}{\alpha} + \frac{V_m}{\beta}\right)$$

The total distance travelled by the train = Distance

$$t_2 = \frac{V_1 - V_2}{f_c}$$

$$50 \times 0.451 = 60 - V_2$$

$$V_2 = 60 - 50 \times 0.451 = 37.45 \text{ kmph}$$

$$t_3 = \frac{V_2}{\beta}$$

$$\beta = \frac{V_2}{t_3} = \frac{37.45}{20} = 1.872$$

$$S = \frac{1}{2} V_1 \frac{t_1}{3600} + \frac{V_1 + V_2}{2} \frac{t_2}{3600} + \frac{1}{2} V_2 \frac{t_3}{3600}$$

$$= \left(\frac{1}{2} \times 60 \times \frac{30}{3600}\right) + \left(\frac{60 + 37.45}{2}\right)\left(\frac{50}{3600}\right) + \left(\frac{1}{2} \times 37.45 \times \frac{20}{3600}\right)$$

$$S = 1.03 \text{ km.}$$

$$\text{specific energy output} = \frac{0.01072}{S} V_m^2 \times \frac{We}{W} + 0.2778 \times r \times \frac{S_1}{S}$$

$$= \left(\frac{0.01072}{1.03} \times (60)^2 \times 1.1\right) + \left(0.2778 \times 40 \times \frac{0.25}{1.03}\right)$$

$$= 43.911$$

$$\text{specific energy consumption} = \frac{\text{specific energy output}}{\text{efficiency}}$$

43.911 58.548 watt-hr

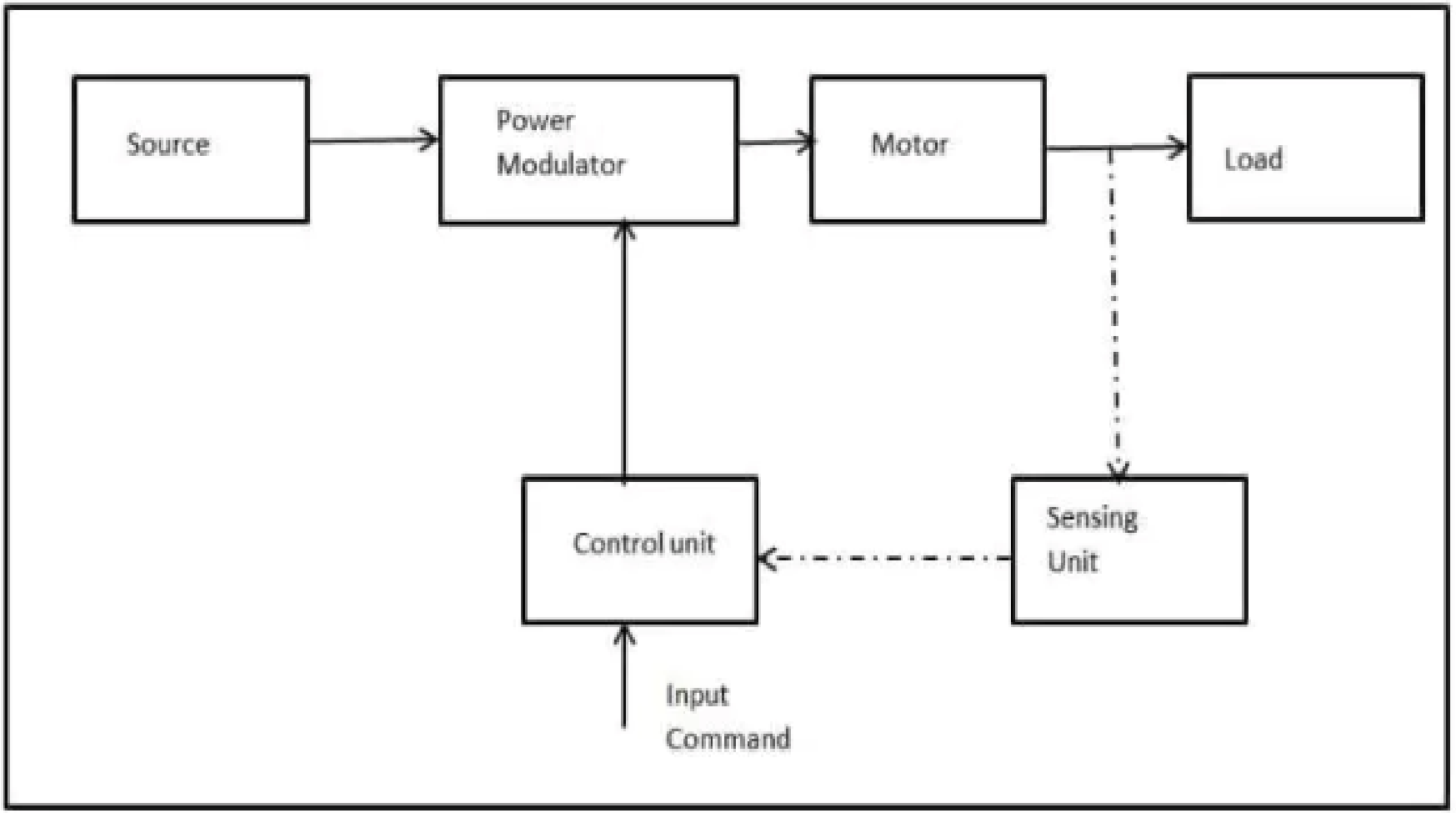
ELECTRIC DRIVES

What is an Electric Drive?

Systems employed for motion control are called drives.

It is a form of machine equipment designed to convert mechanical energy into electrical energy to provide electric control of the process

Basic block diagram



Applications

- Rolling Mills
- Paper Mills
- Textile mills
- Machine Tools
- Transportation systems
- Washing Machine
- Fans & Pumps
- Robots

Advantages

1.They have comparatively long life than the mechanical drive.
2.It is cleaner as there is no fuel required.
3.It is more economical.
4.They have flexible control characteristics.
5.No need to store fuel or transportation.
6.Require less maintenance.
7.Donot pollute environment.
8.The electrical energy can be easily transmitted by using transmission lines over long distances.
9.Remote control operation is feasible whereas in other drives, it is not possible .
10.Smooth speed control is easy.
11.Being compactness, they require less space.
12.They can be started instantly and can be immediately be fully loaded.
13.It is reliable source of drive.
Available in wide range of torque, speed and power.
14.They can operate in all quadrant of speed torque plane.

Disadvantages

- In case of failure of power supply, the electric drive comes to rets position which may paralyze the whole system.
- It cannot be employed in distant places where electric power supply is not available.
- In case of faults like short circuits, breakdown of overhead conductors the electric drive system may get damaged

AC and DC systems

AC system is preferred because

- It is cheaper
- It can be easily transmitted with low-line losses.
- It can be easy to maintain the voltage at consumer premises with in prescribed limits.
- It is possible to increase or decrease the voltage without appreciable loss of power.

DC system is preferred

- In some processes such as electrochemical &battery charging,DC is the only type of power that is suitable.
- The speed control of DC motor is easy rather than AC for variable speed applications such as lift.
- DC series motor is suitable for traction work because of high starting torque.

Factors governing the selection of Electric Motor

- Nature of Electric supply
- Types of Drives
- Nature Of load
- Electrical Characteristics
    - (a) Operating (or)Running characteristics
    - (b)Starting Characteristics
    - (c)Speed Control
    - (d)Braking characteristics

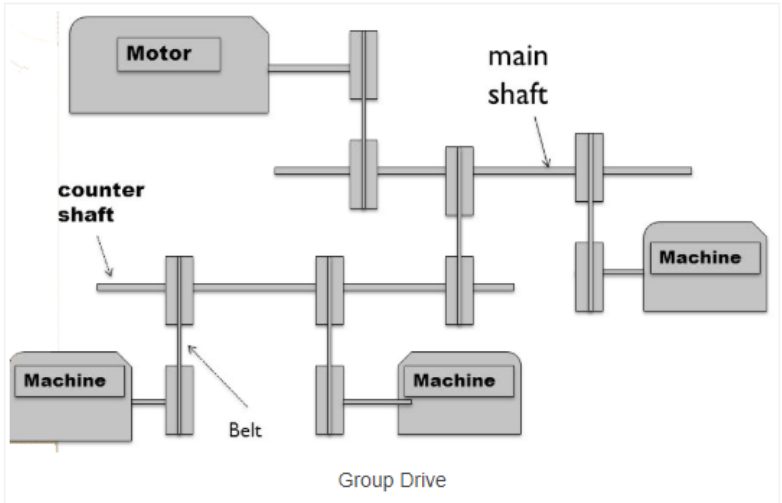
Cont..

- Mechanical Considerations
  - (a)Types of Enclosures
  - (b)Types of bearings
  - (c)Types of transmission for drive
  - (d)Noise Level
  - (e) Heating and cooling time constants of motors
- Service capacity and ratings
- Requirements for continuous, Intermittent(or) variable load cycle
- Pull out torque and overload capacity
- Appearance
- Cost Considerations
  - (a)Capital (or)Initial Cost
  - (b)Running(or)operating cost-powerfactor , losses maintenance & depreciation factor

Types Of Drives

- Group Drive
- Individual Drive
- Multi-motor Drive

Group Drive(or)Line shaft Drive



Group Drive

- A single Electric Motor drives a line shaft by means of which an entire group of working machines may be operated.

Advantages

- The cost of installation is less

  Ex: A single 100kw motors costs much less than of 10 motors of 10kw each
- If it is operated at rated load, the efficiency and powerfactor of large group drive motor will be high.
- The maintenance cost of single large capacity motor is less than no. of small capacity motors.
- It is used for the processes where the stoppage of one operation necessitates the stoppage of sequence of operations as in the case of textile mills.
- It has the overload capacity(An 100% overload on individual machine would mean to say 8 to 10% overload of main motor.)

Disadvantages

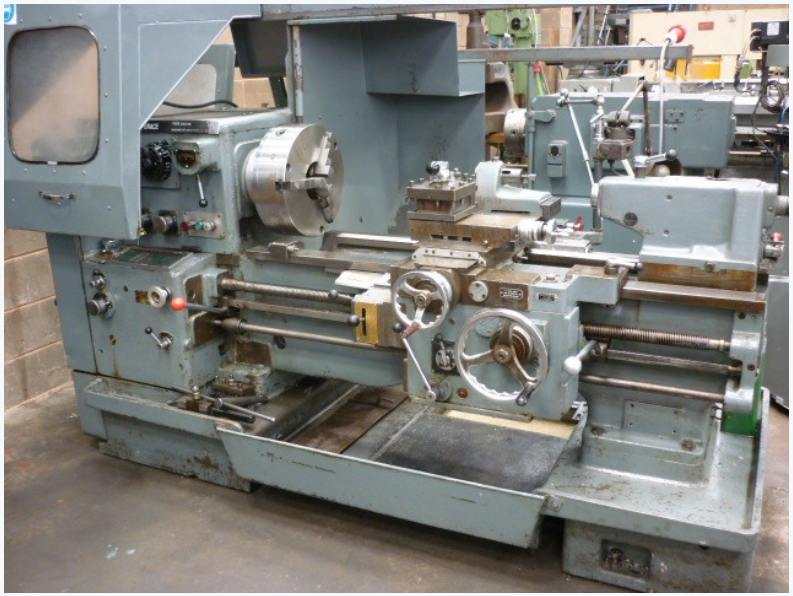
- It is not possible to install any machine at a distant places.
- Speed control of individual machine is difficult.
- The flexibility of layout is lost due to line shaft, belt& pulleys.
- The possibility of Installation of additional machines in an existing industry is limited.
- If there is any fault in the main motor, all the machines connected to the motor will fail to operate, thereby paralyzing a part of industry until the fault is removed.
- The level of noise produced at the work site is quite large.
- It does not provide good appearance.

Individual drive

A single electric motor is used to drive one individual machine

Ex: Single spindle drilling machines, various types of electric hand tools

- Costs more than a group drive.
- Motor and its control unit can be built as an integral part which results in good appearance, cleanliness and safety
- Has complete control of his machine which enables to vary its speed if necessary and stop while not in use, thus eliminate no load losses.
- For driving heavy machines such as for lifts, cranes, shapers, lathes etc., where constancy of speed and flexible speed control is required.
- Thus some power loss occurs in energy transmission mechanism, this drawback is overcome in the case of multi motor drives.



The lathe is a machine tool used principally for shaping pieces of metal (and sometimes **wood** or other materials) by causing the workpiece to be held and rotated by the lathe while a tool bit is advanced into the work causing the cutting action.

A shaper is a type of machine tool that uses linear relative motion between the workpiece and a single-point cutting tool to machine a linear toolpath. Its cut is analogous to that of a lathe, except that it is linear instead of helical.

Multi motor drive

- Consists of several individual drives each of which serves to operate one of many working members or mechanisms in some production unit.

Ex: Travelling Crane--------Three Motors(Hoisting, Long Travel motion, cross travel motion)

Applications:

Complicated Metal cutting machine tools

Paper making machines

Rolling Mills, Rotary printing Machines

Advantages

- Each Machine is driven by a separated motor it can be run and stopped as desired.
- Machines not required can be shut down and also replaced with a minimum of dislocation.
- There is a flexibility in the installation of different machine’s.
- In the case of motor fault, only its connected machine will stop where as others will continue working undisturbed.
- Absence of belts and line shafts greatly reduces the risk of a accidents to the operating personnel.
-

Disadvantage

- Initial high cost

- **WHAT IS ELECTRIC HEATING ?**

WHAT IS THE PRINCIPLE BEHIND IT ?

- **Electric heating** is any process in which ELECTRICAL ENERGY is converted to “**HEAT ENERGY”. Electric heating** works on the principle of ”**JOULE HEATING”** (an electric current through a resistor converts electrical energy into heat energy.)

INTRODUCTION

Electrical heating is based on the principle of that when electric current passes through a medium heat is produced. Let us take the case of solid material which as resistance ‘R’ ohms and current flowing through it is I amps for ‘t’ seconds than heat produced in the material will be $H=I^2Rt$ Joules.

ADVANTAGES OF ELECTRICAL HEATING OVER OTHER METHOD OF HEATING

- Economical.
- Cleanliness
- Absence Of flue gases
- Ease of Control
- Automatic Protection
- Upper limit of Temperature
- Special heating requirement.
- High efficiency of utilization
- Better Working condition.
- Safety

DOMESTIC APPLICATIONS OF ELECTRICAL HEATING

- Room heater for heating the building
- Immersion heater for water heating
- Hot plates for cooking
- Geysers
- Electric kettles
- Electric Iron
- Electric oven for baking products
- Electric toasters etc…

INDUSTRIAL APPLICATION

- Melting of metals
- Electric welding
- Mouldling of glass for making glass appliances
- Baking of insulator
- Mould ling of plastic components
- Heat treatment of pointed surpasses
- Making of plywood.

TRANSFER OF HEAT

- **Conduction:-** This phenomenon takes place in solid, liquid and gas.
- Heat transfer is proportional to the difference of temperatures between two faces, i.e. the rate of conduction of heat along a substance depends upon the temperature gradient

CONVECTION:

- This phenomenon takes place in liquid and gas. Heat is transferred due to actual motion of molecules
- The convention current give up some of their heat to the colder parts of the room.
- The room and its contents are thus gradually heated by this means.

RADIATION:

- In this mode of heat transfer the heat reaches the substance to be heated from the source of heat without heating the medium in between.
- Rate of heat radiation is given by Stefan's law

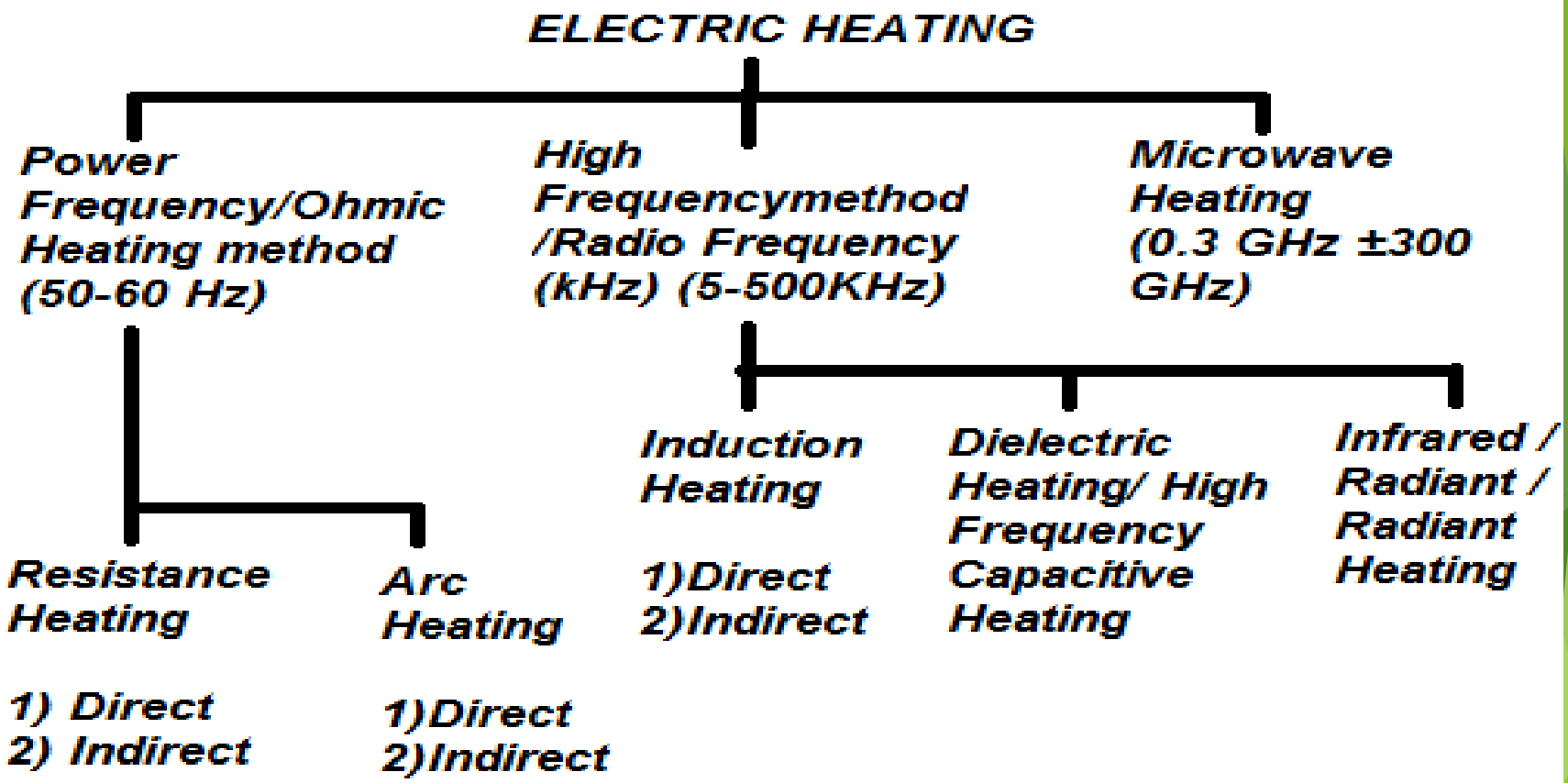
Classification of Heating Method:-

- Low Temperature Heating **± up to 400°C**

  Medium Temperature Heating **± from 400°C to 1150 °C**

  High Temperature Heating **± above 1150 °C**

CLASSIFICATION OF ELECTRICAL HEATING



Characteristics of Heating Elements

1) high resistivity
2) able to withstand high temperatures without deterioration(high melting point)
3) low temperature coefficient of resistance
4) free from oxidation at high temperatures

- Nickel, chromium alloys are used for temp.1,150 °c (good resistance to oxidation at higher temp. with good strength)
- Nickel, chromium, Iron alloys are used for temp. 950 °c

  (reduces the temp at which oxidation takes place)
- Iron, Cobalt, chromium and aluminium can withstand upto 1350 °c
- Nickel, copper alloy for low temperature(it has zero temp coefficient).
- Iron, chromium, aluminium(good resistance to oxidation at high temp. but less mechanical strength)
- Silicon carbide, molybdenum, tungsten and graphite are used above 1,150 °c
- Molybdenum resisters above 1650 °c
- Tungsten resistors above 2000 °c
- Graphite resistors for any temperature.

RESISTANCE HEATING (Example – Electric Water Heater)

This method is based upon the I^2R loss. Whenever current is passed through a resistor material heat is produced because of I^2R losses.

The generation of heat is done by electric resistor carrying current.

RESISTANCE HEATING

DIRECT HEATING

- Electric current is passed through the body (charge) to be heated.
- High efficiency
- Mode of heat transfer is Conduction
- Example-

1) Electrode boiler for heating water

2)Resistance Welding

INDIRECT HEATING

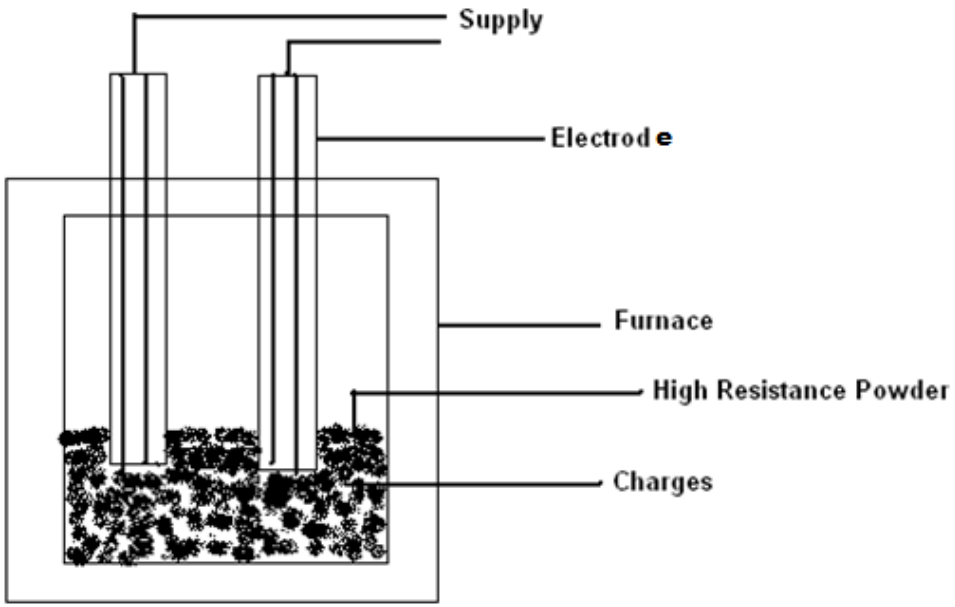
- Electric current is passed through highly resistive material(heating element) placed inside an oven.
- Heat produced due to I^2R loss in the element is transmitted to the body
- Mode of heat transfer is Conduction &/or Convection &/or Radiation
- Example-

1) Room Heaters

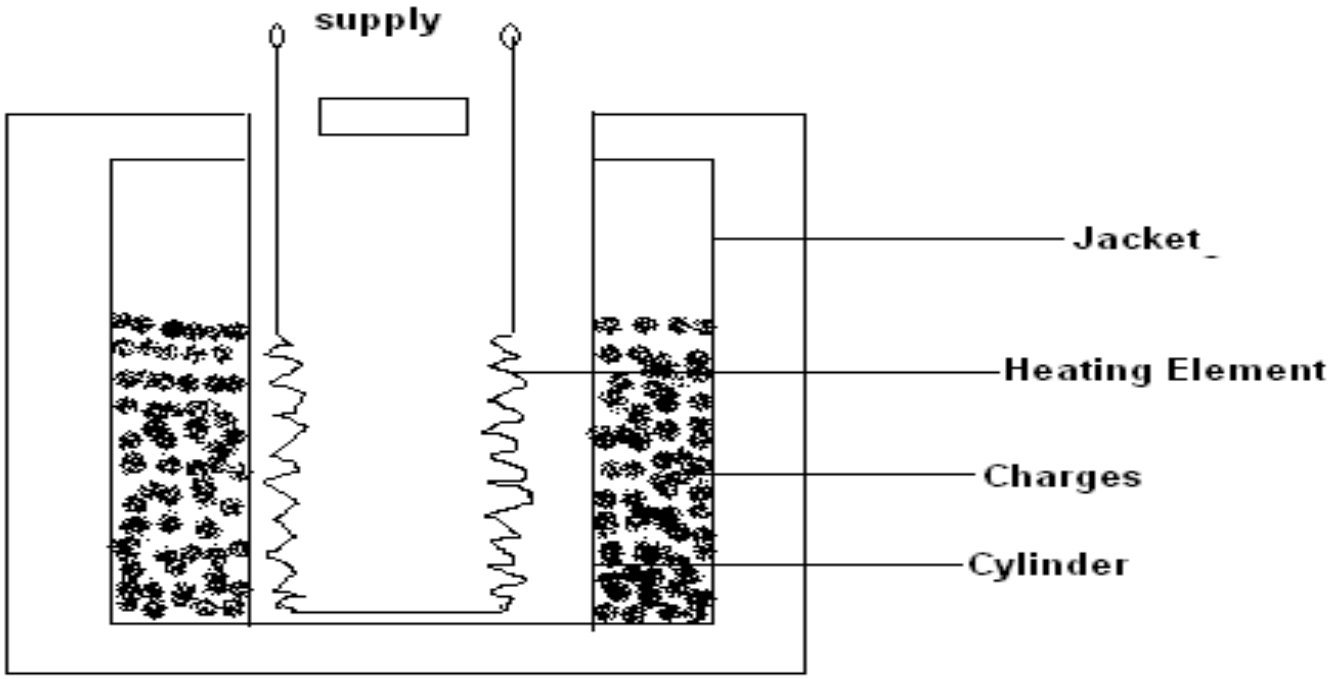
2) Domestic & commercial cooking

3) Heat treatment of metals

1. DIRECT RESISTANCE HEATING



2. INDIRECT RESISTANCE HEATING



Design of Heating Element

- Knowing the electrical input and its voltage the size and length of the wire required as the heating element to produce the given temperature can be calculated.
- The heating element may be circular or rectangular like ribbon
- The heating element on reaching a steady state will dissipate the heat from its surface equivalent to electrical input

As per Stefan's law of radiation, heat radiated by a hot body is given by

$$H = 5.72 eK\left[\left(\frac{T_1}{100}\right)^4 - \left(\frac{T_2}{100}\right)^4\right] \text{W/m}^2$$

where $T1$ is the temperature of hot body in °K and $T2$ that of the cold body (or cold surroundings) in °K

$$\text{Now,} \quad P = \frac{V^2}{R}, \quad \text{and} \quad R = \rho\frac{l}{A} = \rho\frac{l}{\pi d^2/4} = \frac{4\rho l}{\pi d^2}$$

$$\therefore \quad P = \frac{V^2}{4\rho l/\pi d^2} = \frac{\pi d^2 V^2}{4\rho l} \quad \text{or} \quad \frac{l}{d^2} = \frac{\pi V^2}{4l\rho}$$

Total surface area of the wire of the element = $(\prod d) \times l$ ..... *i*

If H is the heat dissipated by radiation per second per unit surface area of the wire, then heat radiated per second = $(\prod d) \times l \times H$ ..... *ii*

Equating ***(i)*** and ***(ii)***, we have

$$P = (\pi d) \times l \times H \quad \text{or} \quad \frac{\pi d^2 V^2}{4\rho l} = (\pi d) \times H \text{ or } \frac{d}{l^2} = \frac{4\rho H}{V^2} \quad \text{..... } iii$$

We can find the values of l and d from Eq. ***(i)*** and ***(iii)*** given above.

Ribbon Type Element

If w is the width of the ribbon and t its thickness, then

$$P = \frac{V^2}{R} = \frac{V^2}{\rho l / A} = \frac{V^2}{\rho l / Twt} = \frac{wtV/^2}{\rho l} \quad or \quad \frac{t}{wt} = \frac{V^2}{\rho P}$$

……iv

Heat lost from ribbon surface = $2wl\,H$ (neglecting the side area $2tl$)

$$\therefore \quad \frac{wtV^2}{\rho l} = 2wlH \quad \text{or} \quad \frac{t}{l^2} = \frac{2\rho H}{V^2}$$

……v

CAUSES OF FAILURE OF HEATING ELEMENTS

- Formation of hot spots.

  due to the high rate of local oxidation, shielding of element by supports

- Oxidation and intermittency of operation
- Embrittlement due to Grain Growth
- Contamination and Corrosion

Infrared (or) Radiant heating

- In this method heating elements consist of tungsten filament lamps together with reflectors.
- Lamps are operated at 3000 °c_.
- Reflectors are plated with rhodium(harder,longlife,easy to maintain).
- The lamps used are usually 250 and 1000 watts operating at 115 volts.
- Plant sizes ranges from single lamp to several KW of lamps.
- Charge temperature of 200 °c to 300 °c_can be obtained.

- Heat emission intensities upto 7000 W/square m of the chamber surface can be obtained where as it is 1500 W/square m for resistance ovens.
- Heat absorption practically remains constant where as it falls as temp. increases in resistance furnaces.

ADVANTAGES:

1. Rapid heating
2. Compactness of heating units
3. Flexibility
4. Safety

APPLICATIONS:

1. Paint stoving
2. Drying of radio cabinates and wood furniture
3. Preheating of plastics prior to moulding
4. Softening of thermo plastic sheets
5. Drying of pottery,paper,textiles etc.,

Induction Heating

- This heating process makes use of the currents induced by the electro-magnetic action in the charge to be heated.
- Low-frequency induction furnaces:

  melting and refining of different metals.
- High-frequency eddy-current heating:

  hardening and soldering

When an a.c. voltage is applied

- to the primary, it induces voltage in the secondary *i.e. charge. The secondary current heats up*
- If *V* is the voltage induced in the charge and *R is the charge resistance, then heat produced = V 2/R.*
- The value of current induced in the charge depends on

  (i) magnitude of the primary current

  (ii)turn ratio of the transformer

Low frequency induction furnaces

a) Core-type Furnaces

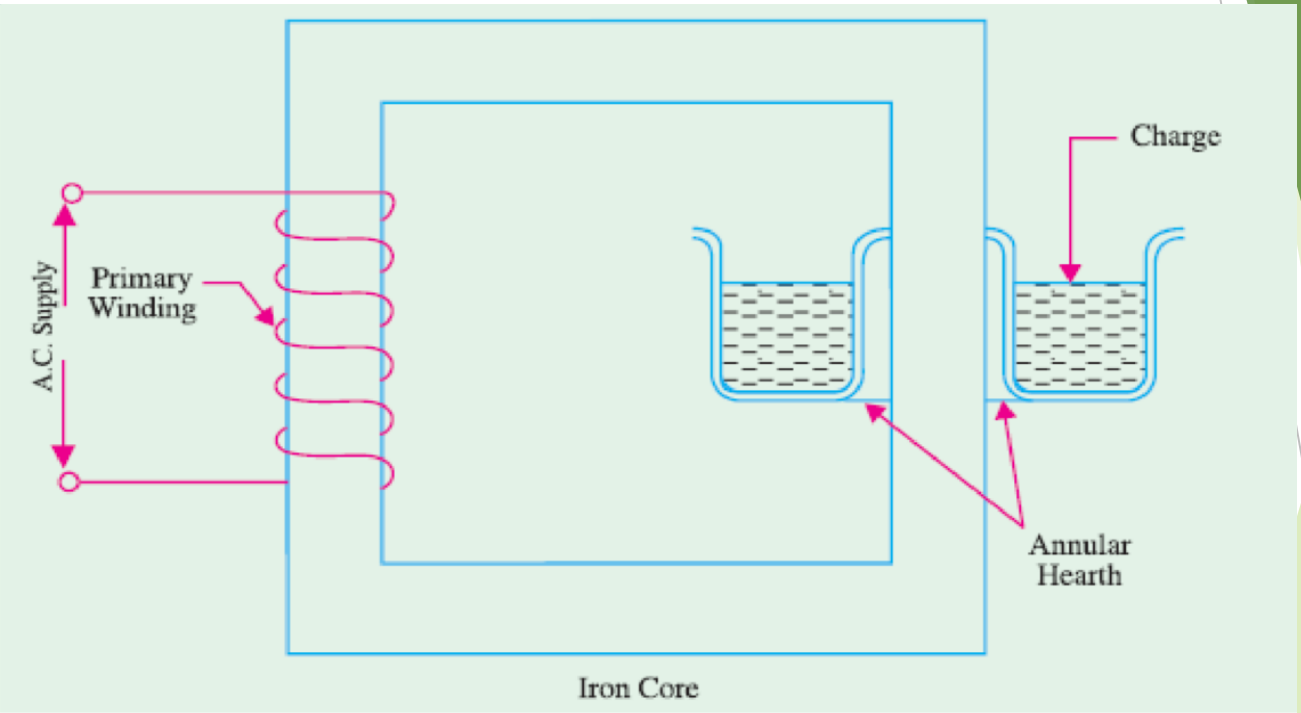
(i) Direct core-type furnaces

(ii) Vertical core-type furnaces and

(iii) Indirect core-type furnaces.

(b) Coreless-type Furnaces

Direct core-type furnace



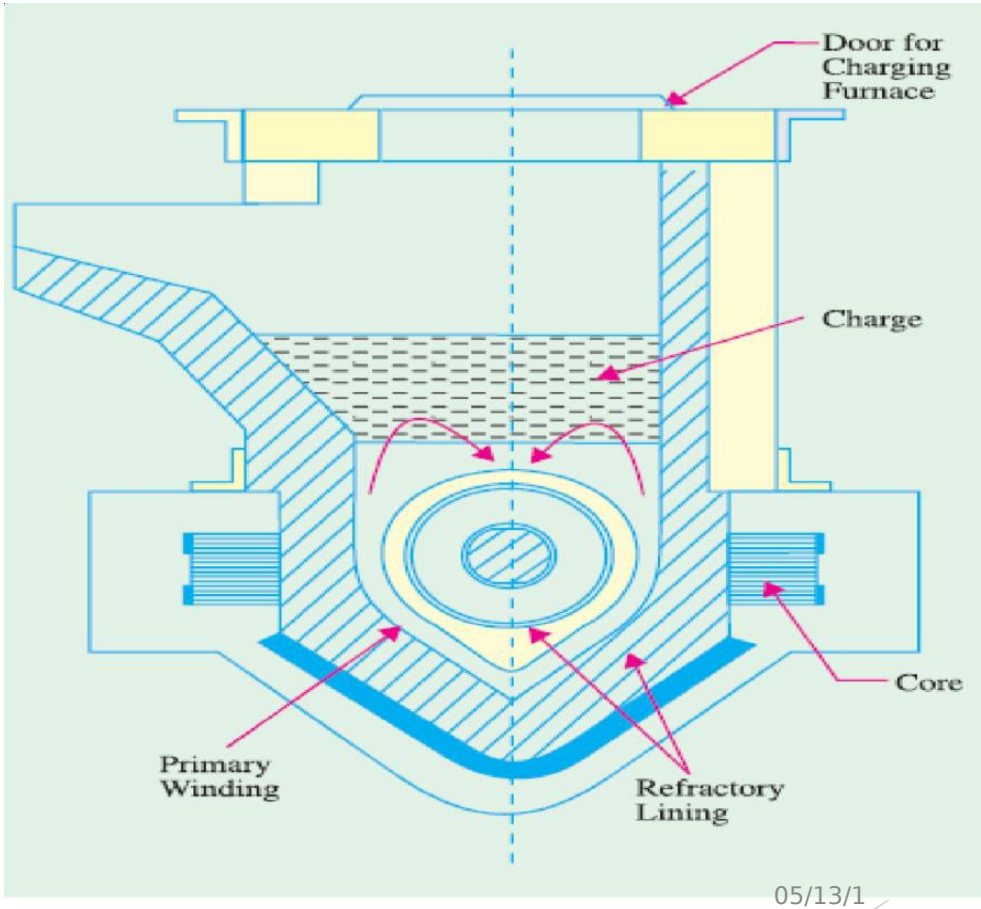
Drawbacks

This furnace suffers from the following drawbacks:

1. It has to be run on low-frequency supply which entails extra expenditure on motor-generator set or frequency convertor.
2. It suffers from pinching effect.
3. The crucible for charge is of odd shape and is very inconvenient for tapping the molten charge.
4. It does not function if there is no molten metal in the hearth *i.e.* when the secondary is open. Every time molten metal has to be poured to start the furnace.
5. It is not suitable for intermittent service. However, in this furnace, melting is rapid and clean and temperature can be controlled easily.

Moreover, inherent stirring action of the charge by electro-magnetic forces ensures greater uniformity of the end product.

Vertical core-type furnace (or)Ajax wyatt vertical core type furnace



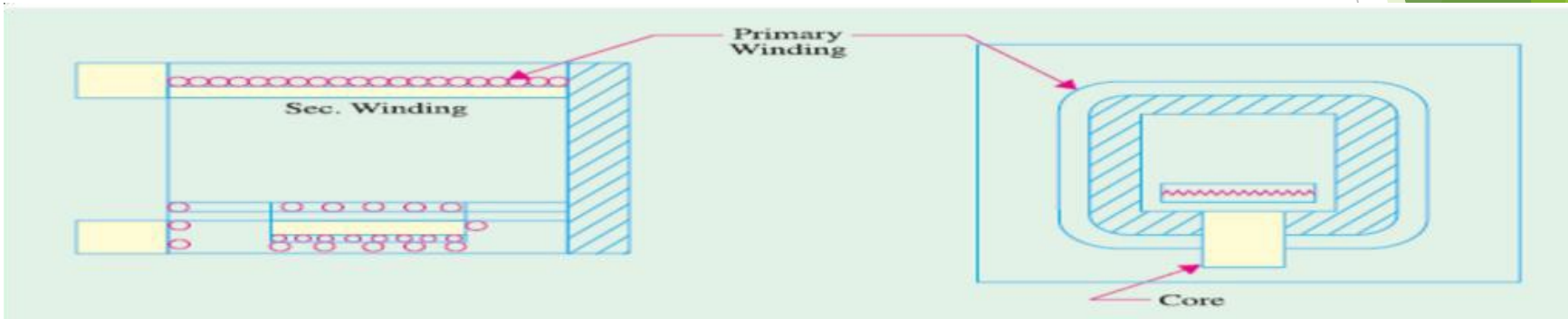
Vertical core-type furnace

- It is also known as Ajax-Wyatt furnace and represents an improvement over the core-type furnace
- In this furnace, magnetic coupling is comparatively better and power factor is high.
- Hence, it can be operated from normal frequency supply.
- This furnace is widely used for melting and refining of brass and other non-ferrous metals.
- It has a p.f. of 0.8-0.85.
- Efficiency is about 75% and its standard size varies from 60-300 kW
- Vertical core avoids the pinch effect due to weight of the charge in the main body.

Advantages

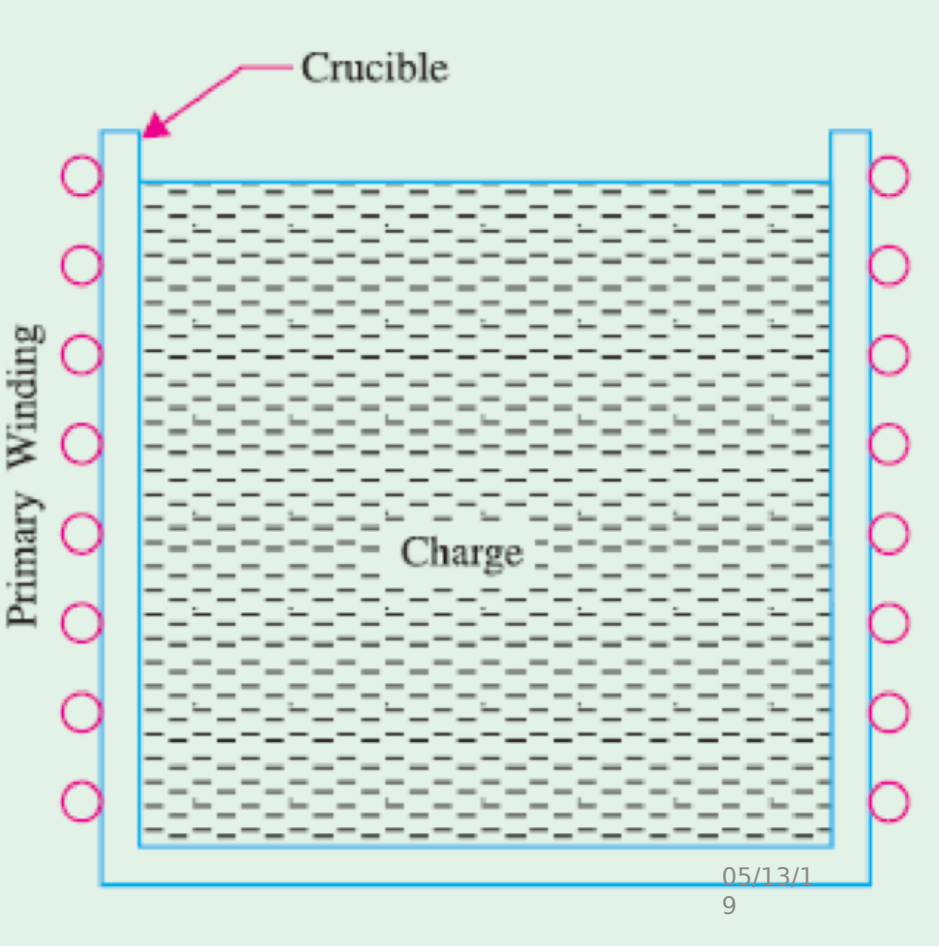
- Highly efficient heat, low operating costs and improved production
- Absence of crucibles
- Ideal working conditions in a cool atmosphere with no dirt, noise or fuel
- Absence of combustion gases resulting in elimination of the most common source of metal contamination
- Accurate temperature control ,uniform castings, reduced metal losses and reduction of rejects

Indirect Core-Type Induction Furnace



- The secondary consists of a metal container which forms the walls of the furnace proper.
- The primary winding is magnetically coupled to this secondary by an iron core.
- A special advantage of this furnace is that its temperature can be automatically controlled without the use of an external equipment.

Coreless Induction furnace



Advantages

(1) They are fast in operation.

(2) They produce most uniform quality of product.

(3) They can be operated intermittently.

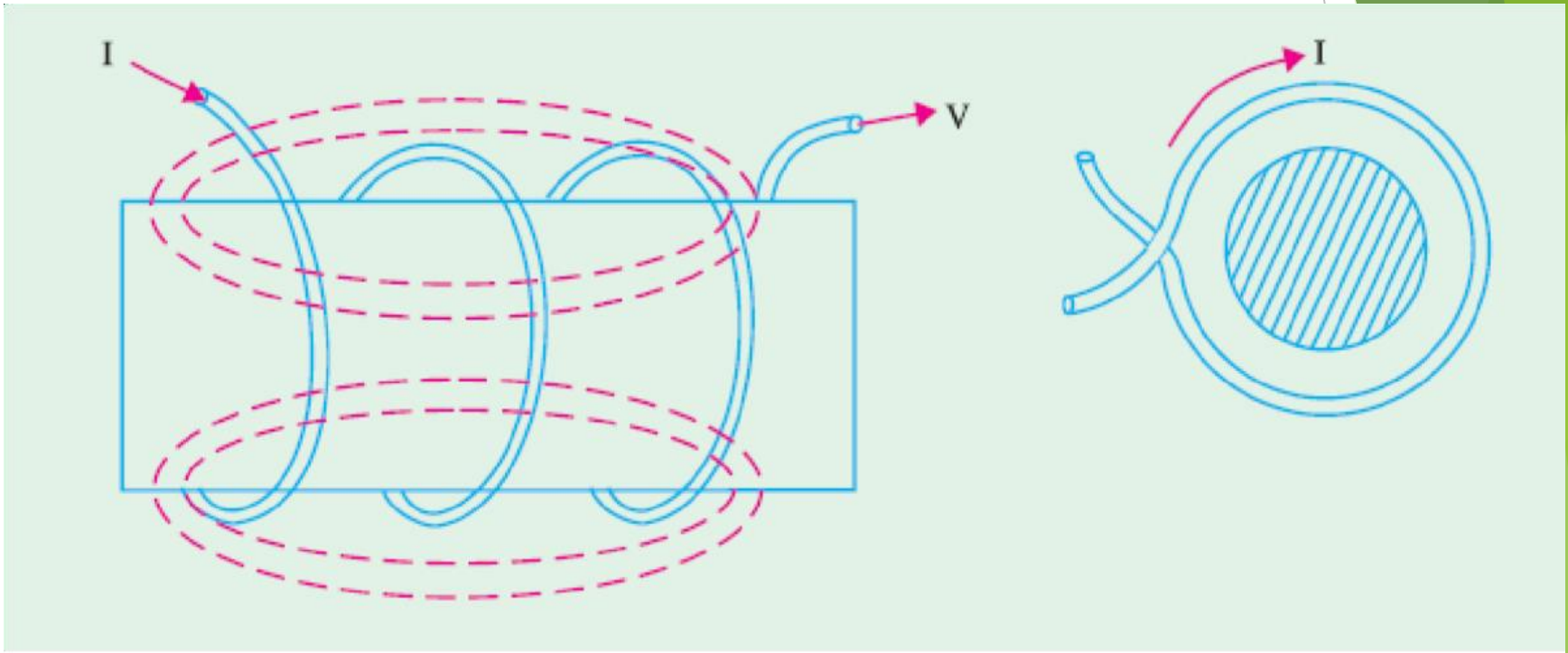
(4) Their operation is free from smoke, dirt, dust and noises.

(5) They can be used for all industrial applications requiring heating and melting.

(6) They have low erection and operating costs.

(7) Their charging and pouring is simple.

High Frequency Eddy-current Heating



Advantages

- There is negligible wastage of heat because the heat is produced in the body to be heated.
- It can take place in vacuum or other special environs where other types of heating are not possible.
- Heat can be made to penetrate any depth of the body by selecting proper supply frequently.

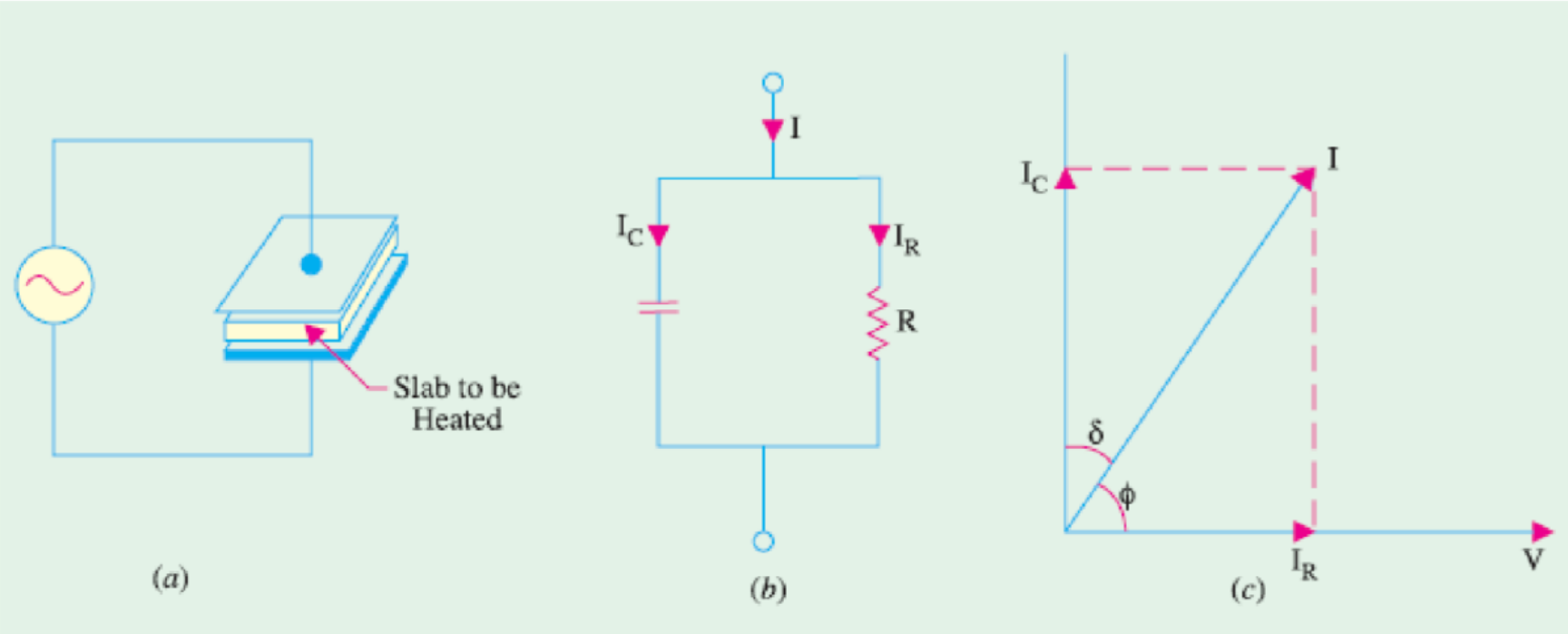
Applications

(1) **Surface Hardening.**

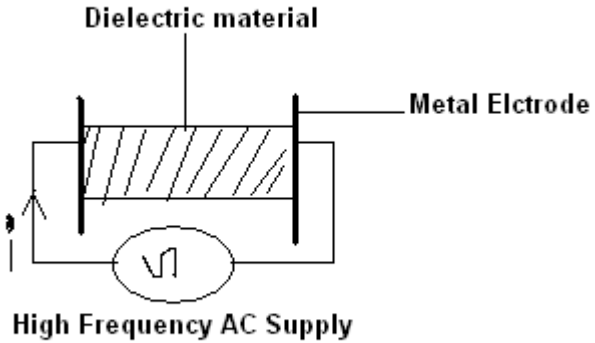
(2) Annealing.

(3) Soldering.

Dielectric Heating



DIELECTRIC HEATING



Dielectric Heating

Dielectric heating, also known as **electronic heating**, **RF heating**, **high-frequency heating** and **diathermy.**

Dielectric heating is a special way of transforming electric current into heat.

By the method of dielectric heating, generally, foils, plates and profiles with a thickness of 0,1-2,0 mm is are welded.

Dielectric Heating (contd…)

- We understand dielectric heating as the generation of thermal energy (heat) in a non-conducting material by the application of an electromagnetic force or field t it. This is the way a microwave oven heats things placed in it.

Applications

- Preheating of plastic preforms
- Gluing of wood
- Baking of foundary cases
- Diathermy
- Sterilization
- Textile Industry
- Electronic sewing
- Food Processing

WELDING

- Welding is a materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material.
- Welding is used for making permanent joints.
- Electrically welded joints are being used to replace rivetted bolted joints.
- It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

TYPES

- **Plastic Welding or Pressure Welding**

  The piece of metal to be joined are heated to a plastic state and forced together by external pressure

  (Ex) Resistance, forge,thermit and gas welding .

- **Fusion Welding or Non-Pressure Welding**

  The material at the joint is heated to a molten state and allowed to solidify

  (Ex) Gas welding, Arc welding and Thermit welding with out pressure.

Classification of welding processes:

Arc welding

- **Carbon arc**
- **Metal arc**
- **Atomic hydrogen**
- **Inert gas metal**
- **Submerged arc**

Resistance Welding

- Butt
- Spot
- Seam
- Percussion
- Projection welding

Resistance welding

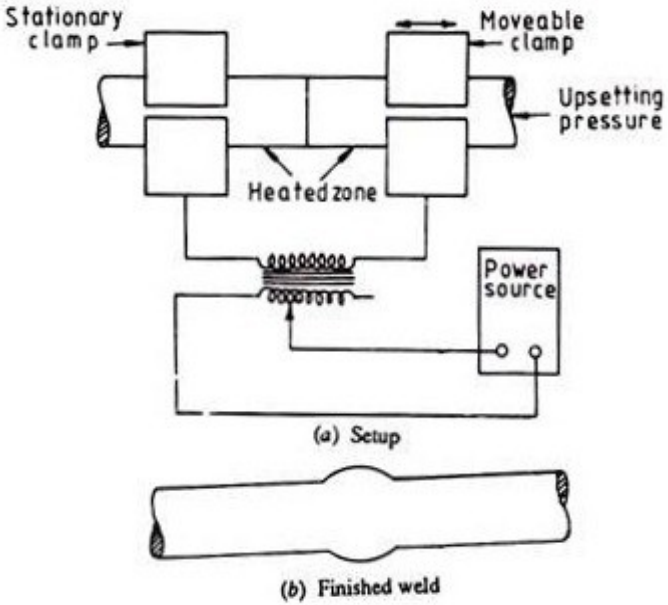
- The principle of resistance welding is the generation of heat in the joint by passing a heavy current through the parts.
- The amount of current necessary is 4400 to 5000Amp.
- The pressure varies from 280 to 565 sq.cm

ADVANTAGES:

- It is a quick method of joining two pieces.
- There is very little wastage of the metal.
- The process can be accurately controlled.
- The welds are consistently uniform.

Butt welding

Upset Butt welding welding



Flash Butt

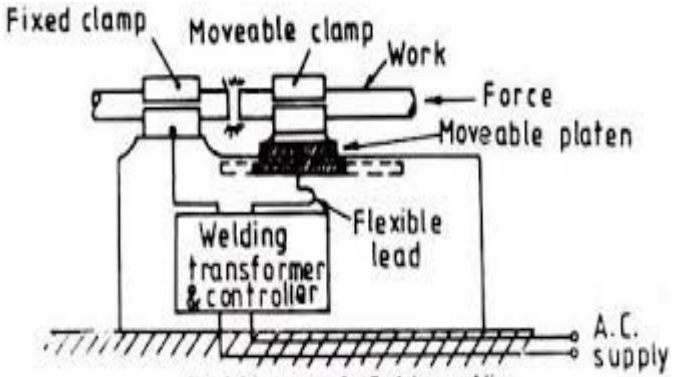


Fig. 2·26 A setup for flash butt welding.

Upset butt welding

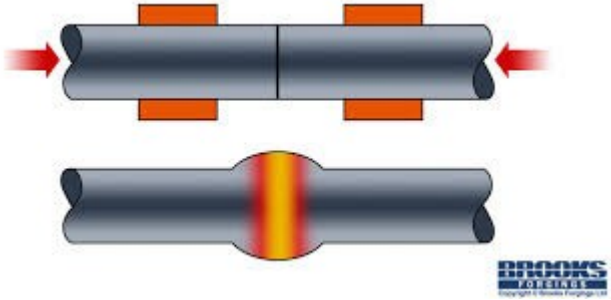
- The metal pieces to be joined are fixed in clamps and butted squarely against each other and heavy current is passed through them.
- Pressure is applied either manually or with toggle mechanism.
- The voltage required is about 2-8 volts and current varies from 50A to several hundred Amps.

Flash butt welding

- In this the voltage to the metal parts to be joined together is applied before putting them together.
- The molten metal is blown out and a small arc if formed which raises the temperature of adjoining parts of the abutting surfaces.

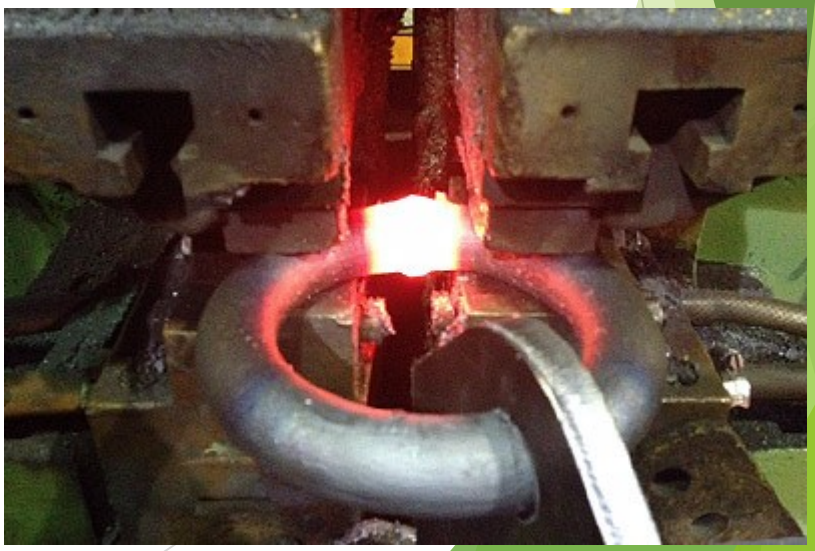
Applications:

- **It is applied primarily in the butt welding of metal sheets, tubing, bars, rods, forging, fittings.**
- **Automotive and aircraft products, household appliances, refrigerators and farm implements.**
- **The process is used for welding the band saw blades into continuous loops and joining of tool steel drill, tap and room bodies to low carbon steel and alloy steel shanks.**


BROOKS
FORGINGS


mig-welding.co.uk


Holland
GRIET

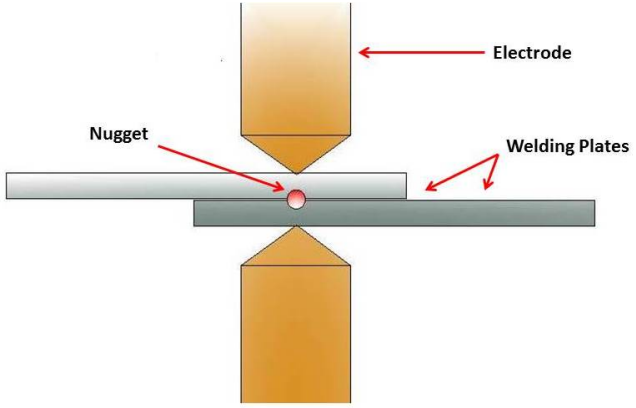


Difference between upset and flash butt welding

- In flash welding, unlike upset butt welding, the movable platen keeps on moving constantly towards the stationary platen.
- Flash welding consumes much less welding current than upset butt welding, but the time allowed for weld to be completed is more in upset butt welding.
- In flash welding heat application precedes the pressure where as in upset butt welding constant pressure is applied during the heating process which eliminates flashing.

Spot welding

- It is a form of resistance welding in which parts or pieces are joined in spots.
- It only provides mechanical strength and is neither air tight or water tight.
- Current required is usually about 5000A and voltage required is usually less than 2V.



Spot Welding

Spot welding

APPLICATIONS

- Automobile industry
- Dental Prosthesis
- Batteries
- Nuts and Bolts

Resistance Seam Welding

- RSEM is modification of spot welding wherein the electrodes are replaced by rotating wheels or rollers
- The electrically conducting rollers produce a spot weld
- RSEM can produce a continuous seam & joint that is liquid and gas tight

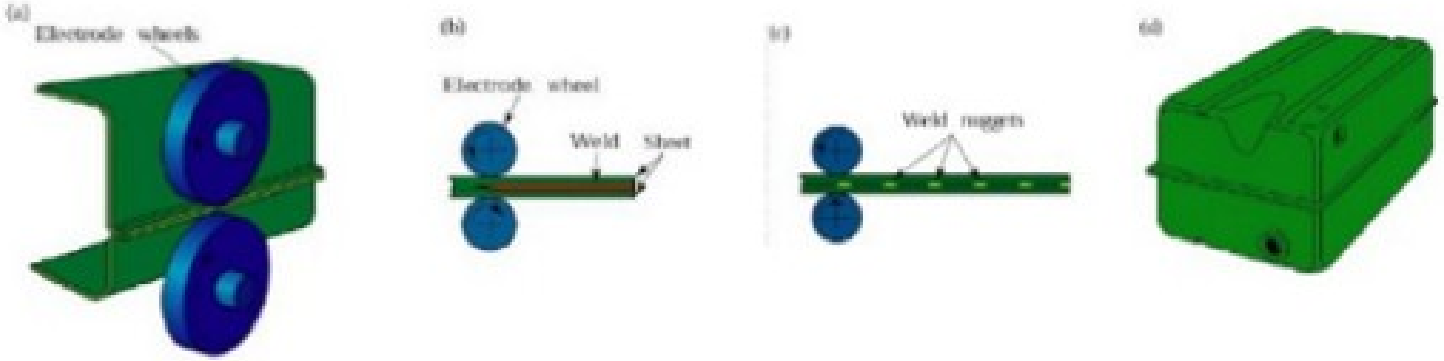
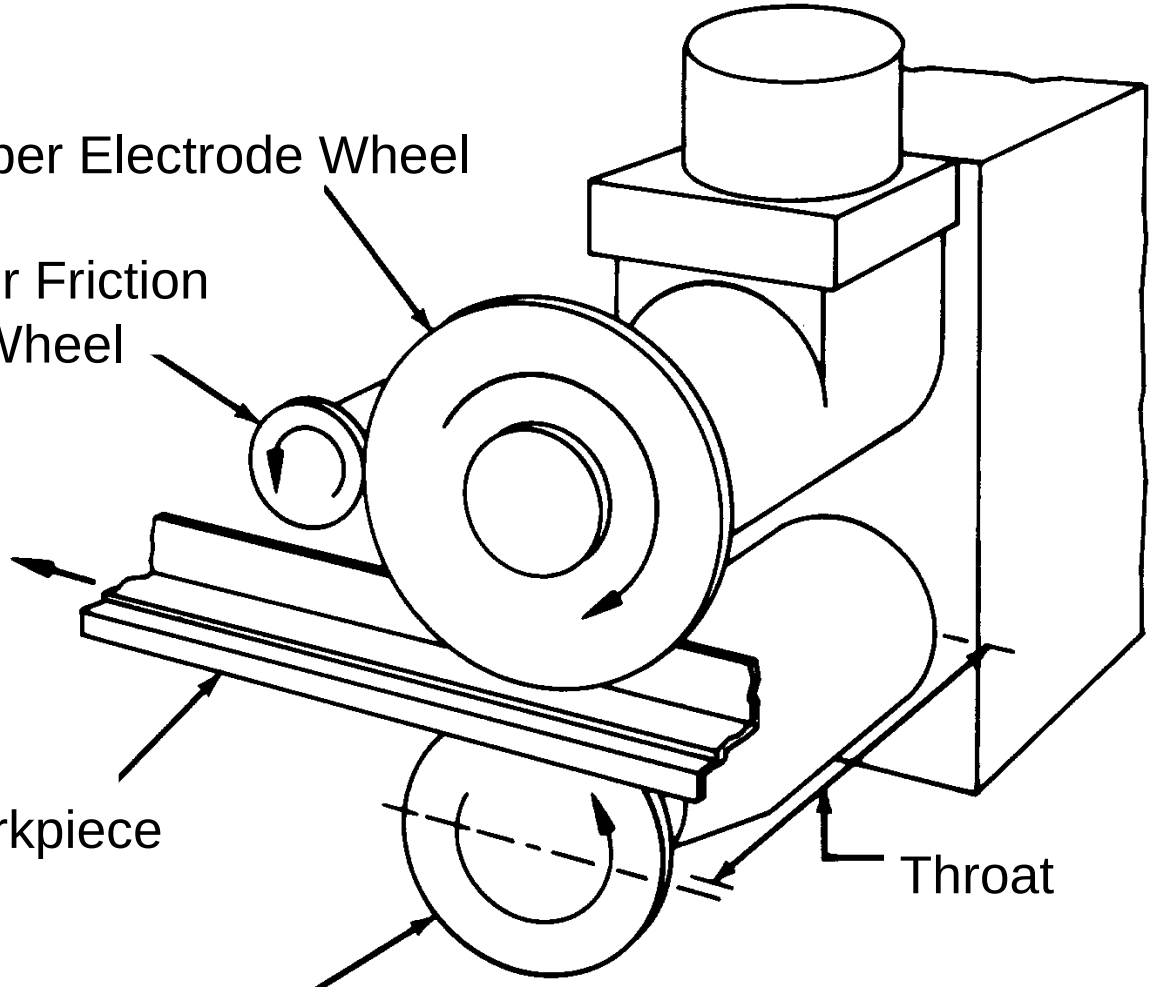
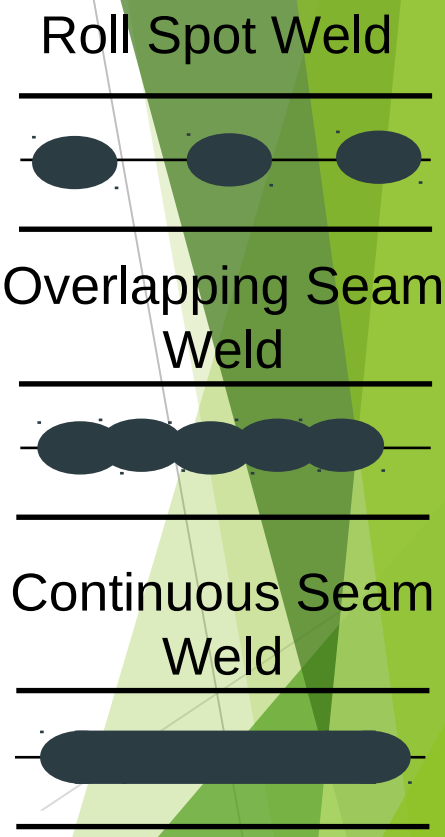


Fig : (a) Seam-Welding Process in which rotating rolls act as electrode (b) Overlapping spots in a seam weld. (c) Roll spot weld (d) Resistance-welded gasoline tank

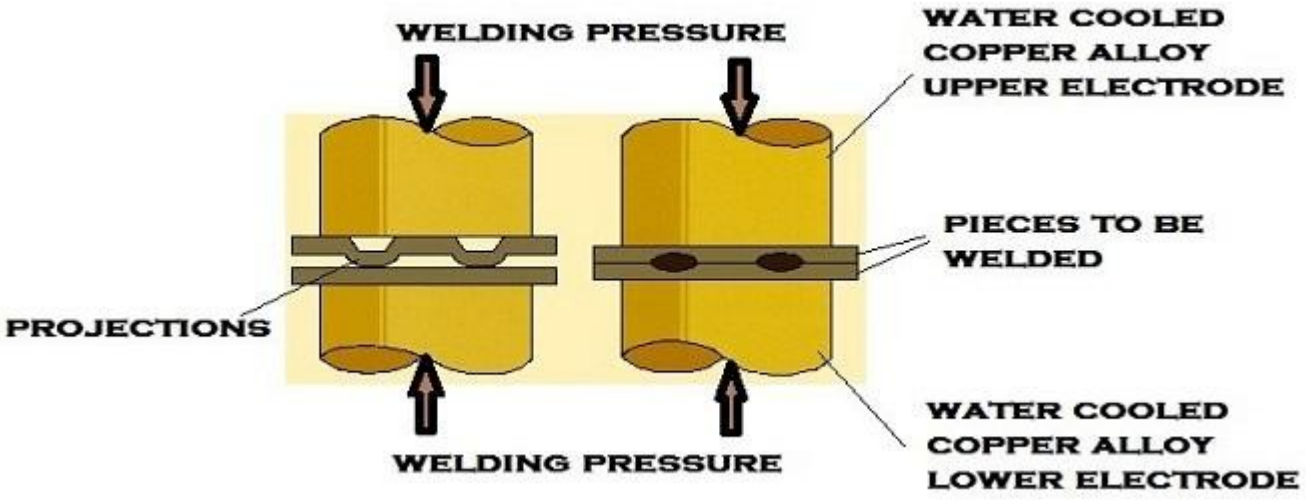
Resistance Seam Welding





[Reference: Welding Handbook, Volume 2, p.553, AWS]

Projection welding



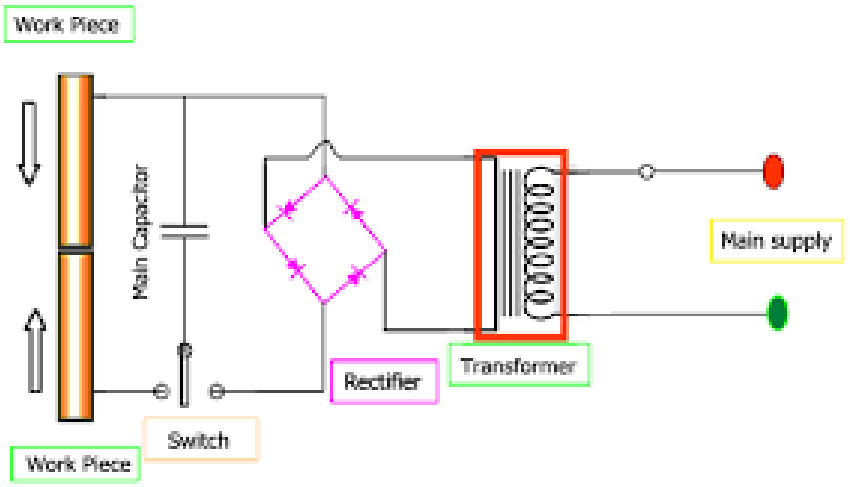
- It is a resistance welding process that produces the coalescence by the heat obtained from the resistance to the flow of the welding current.
- As the point reaches their plastic state, the metal is compressed so that finished weld is similar to the spot weld

Advantages over spot welding:

- It makes the welding process similar.
- Welds are automatically located by the position of projection.
- More output is formed since more than one weld is formed at a time.
- As the electrodes are flat, therefore contact area over the projection is sufficient.

Percussion welding

It is a resistance welding where in coalescene is produced over the entire area.



- The advantage of this process is that there is an extremely shallow depth of heating.
- This process is so fast(0.1s)
- This process is limited to only small areas(up to 3.2 sq.cm)
- It is used for welding large number of dissimilar metals.

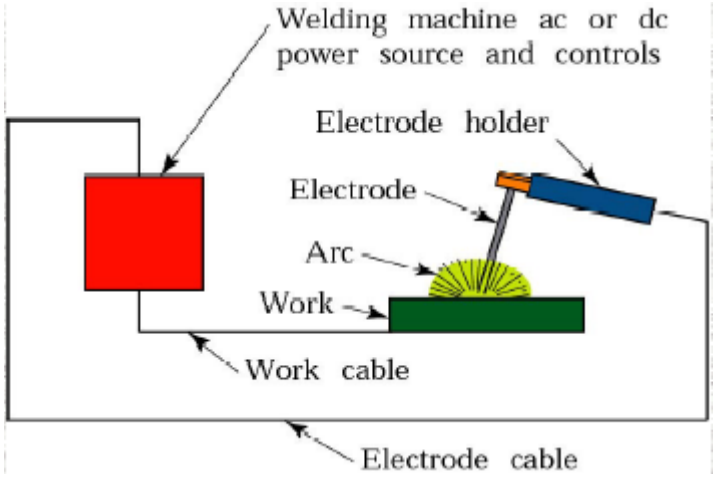
Applications:

Used for welding satellite tips to tools, copper to aluminium or stainless steel, silver contact tips to copper, Cast iron to steel .

Arc welding

- In this electric arc is produced by bringing two conductors(electrode and metal piece) connected to a suitable source of electric current, momentarily in contact and then separating by a small distance.
- Maximum voltage specified for welding is 100V.
- Current ranges from 30 to 500 A for manual and 75 to 600A if it is automatic operated
- Temperature is about 3700 to 4000 degree centigrade
- Either DC or AC may be used

Arc Welding Equipments



It is widely used for joining of metal parts, the repair of fractured casting and the fillings by the deposition of new metal on worn out parts.

Arc Welding

Uses an electric arc to coalesce metals

Arc welding is the most common method of welding metals

Electricity travels from electrode to base metal to ground

Arc welding

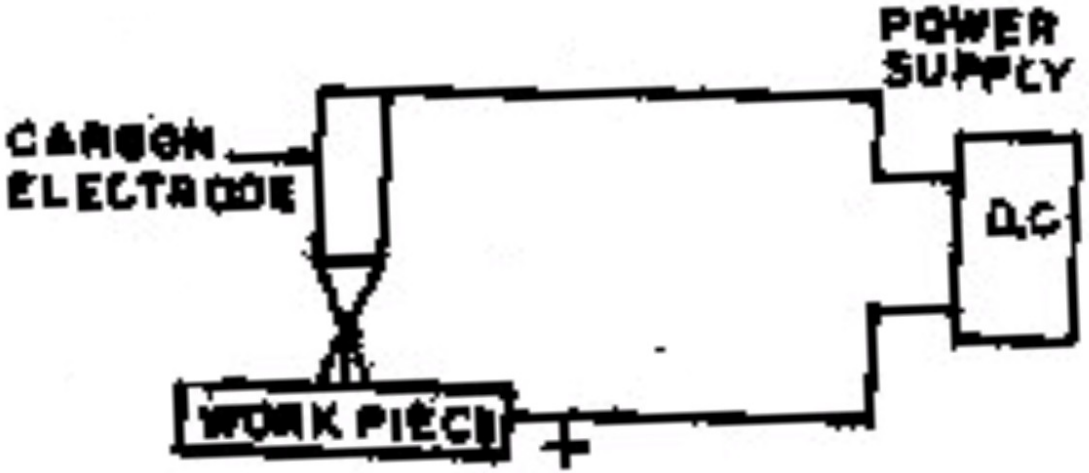
Advantages

- Most efficient way to join metals
- Lowest-cost joining method
- Affords lighter weight through better utilization of materials
- Joins all commercial metals
- Provides design flexibility

Limitations

- Manually applied, therefore high labor cost.
- Need high energy causing danger
- Not convenient for disassembly.
- Defects are hard to detect at joints.

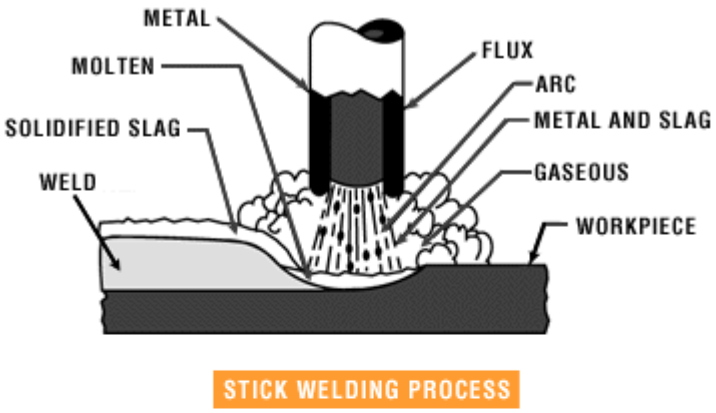
Carbon Arc Welding



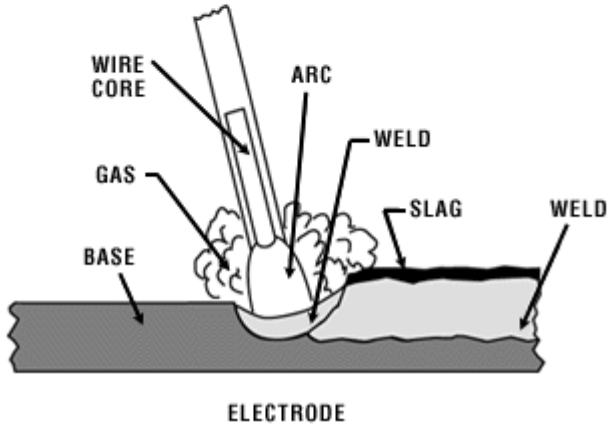
CARBON ARC WELDING

- Normally used for welding copper and its alloys.
- The electrode should be kept negative and the work positive
- For this type only DC is used.
- AC is not preferred because no fixed polarity can be maintained.
- No flux is used(non ferrous) and in other method flux (ferrous)either in the form of powder or paste is used to prevent the welding from oxidation.
- Employed for welding sheet steel, copper alloys, brass ,bronze and aluminium.
- It is not suitable for vertical and overhead welding.

Metal arc welding



STICK WELDING PROCESS



- Electrodes used must be of same metal as that of the workpiece to be welded
- Both AC and DC can be used
- Voltage required for DC is about 50-60V
- Voltage required for AC is about 80-90V
- Current required for welding varies from 10 to 500A

Atomic hydrogen Arc Wlding

- Arc is maintained between two tungsten electrodes under a pressure of about 0.5kg/cm
- It is very expensive
- Employed for welding alloy steel,carbon steel,stainless steel,aluminium etc.,
- For equal consumption of electrodes AC supply is used
- Voltage required for arc striking varies from 80 to 100V

Inert gas metal arc welding

- It is gas shielded metal arc welding
- Inert gas such as helium or organ is blown through the nozzle

Comparison of A.C. and D.C. arc welding

Alternating Current (from Transformer)

More efficiency

Power consumption less

Cost of equipment is less

Higher voltage – hence not safe

Not suitable for welding non ferrous metals

Not preferred for welding thin sections

Any terminal can be connected to the work or electrode

Comparison of A.C. and D.C. arc welding

Direct Current (from Generator)

Less efficiency

Power consumption more

Cost of equipment is more

Low voltage – safer operation

suitable for both ferrous non ferrous metals

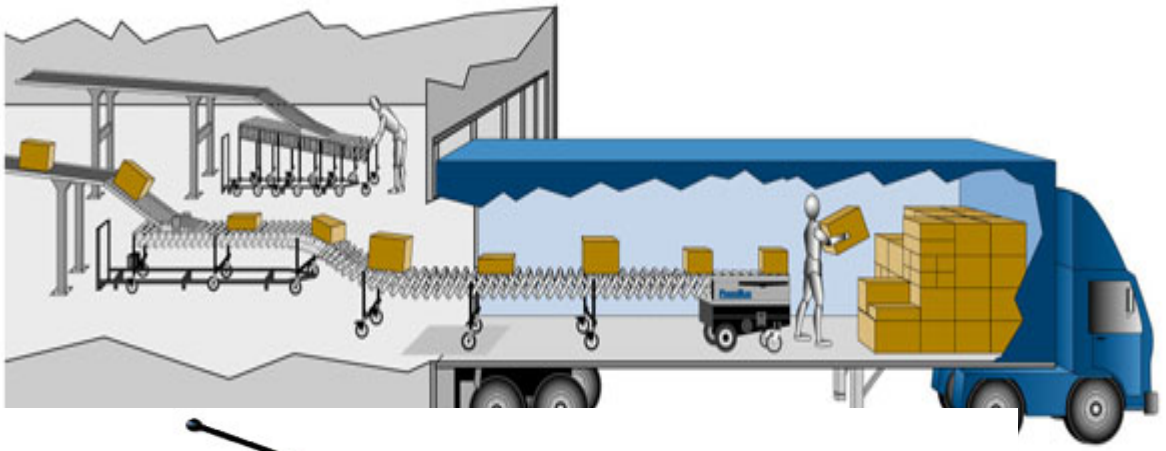
preferred for welding thin sections

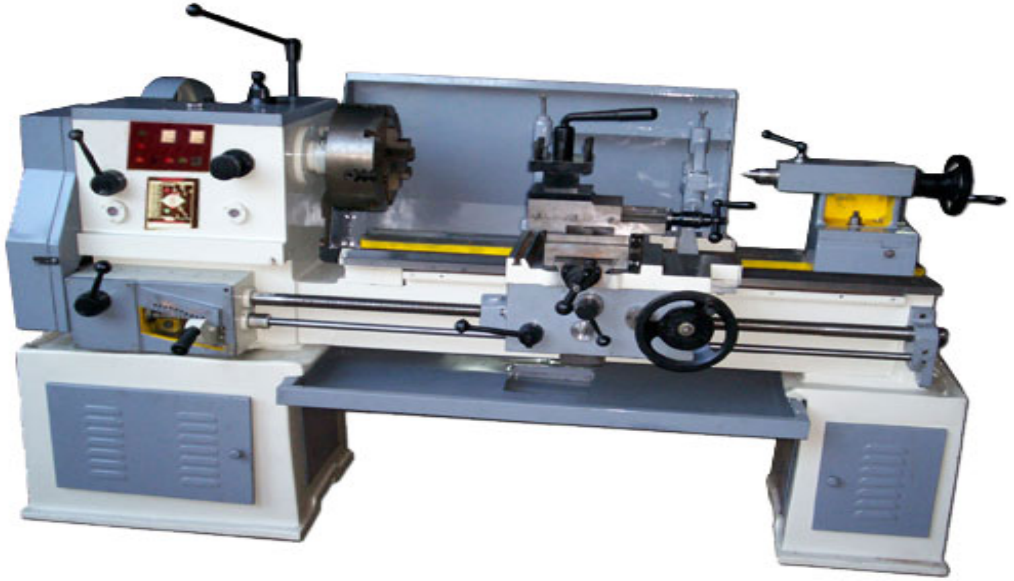
Positive terminal connected to the work

Negative terminal connected to the electrode

Shunt motors

Conveyors





Machine lathes

Milling machines

Hoist Winches

Illumination

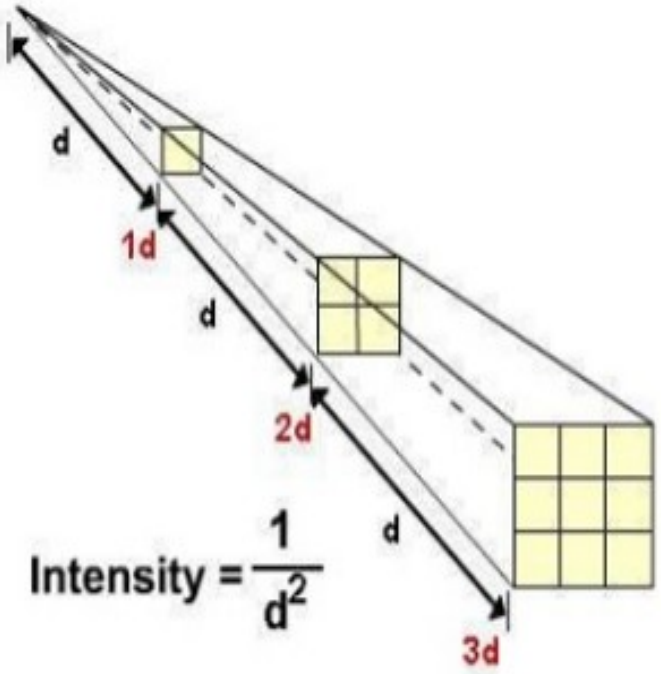
Inverse Square Law

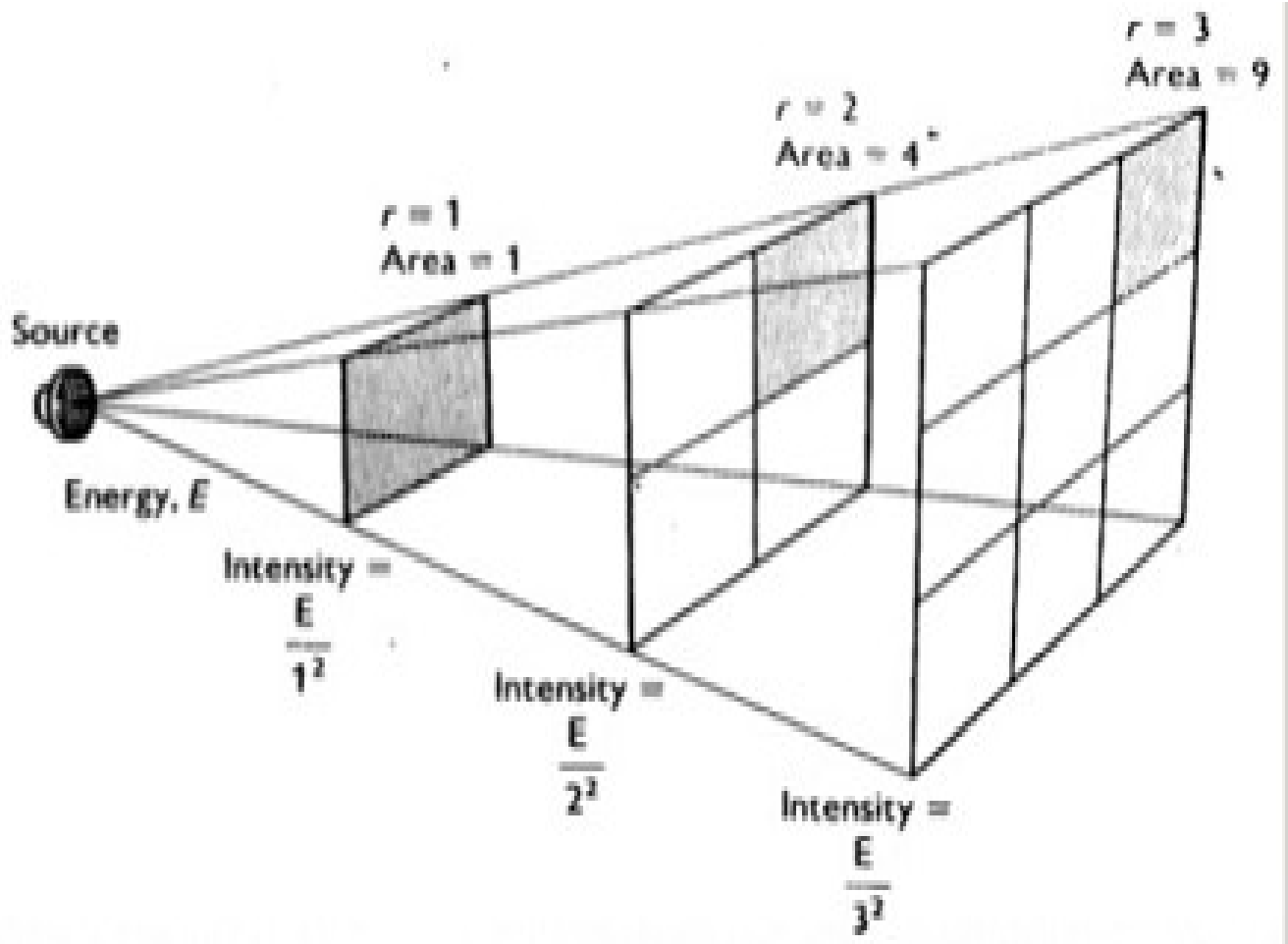
•Intensity of Illumination produced by a point source varies inversely as square of the distance from the source.

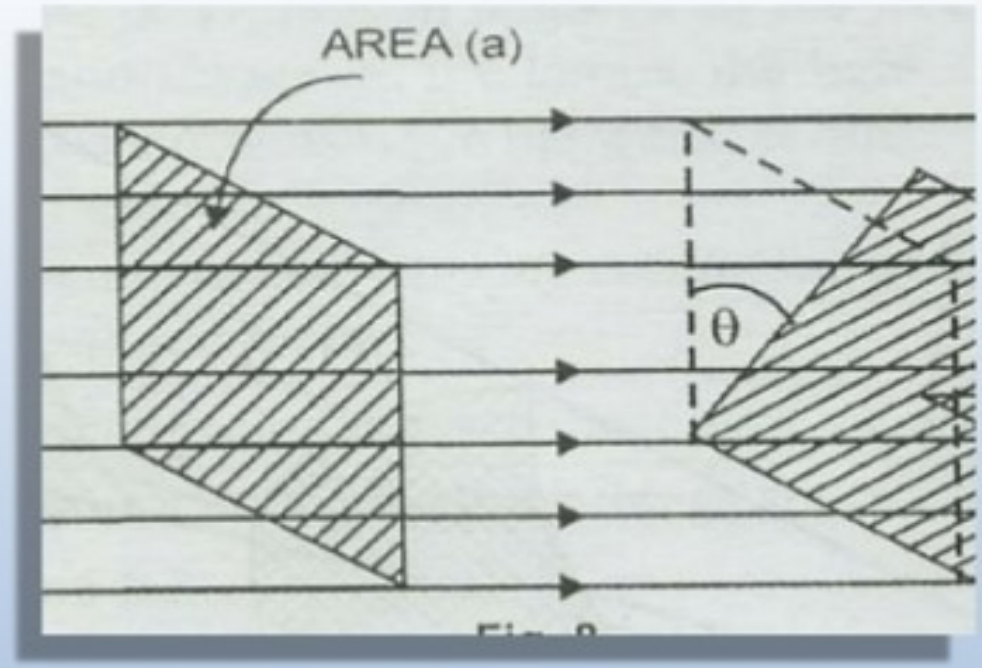
$$E = \frac{I}{d^2}$$

•Where, I is intensity and

•d is Distance



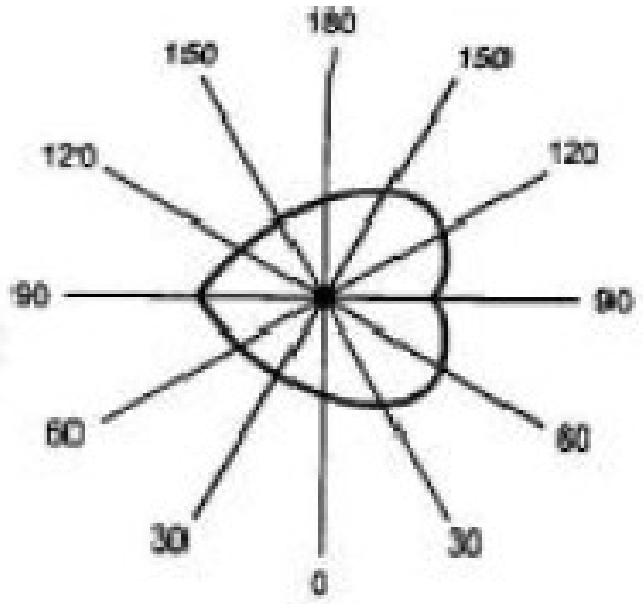

r = 3
Area = 9
r = 2
Area = 4
r = 1
Area = 1
Source
Energy, E
Intensity = E / 1²
Intensity = E / 2²
Intensity = E / 3²



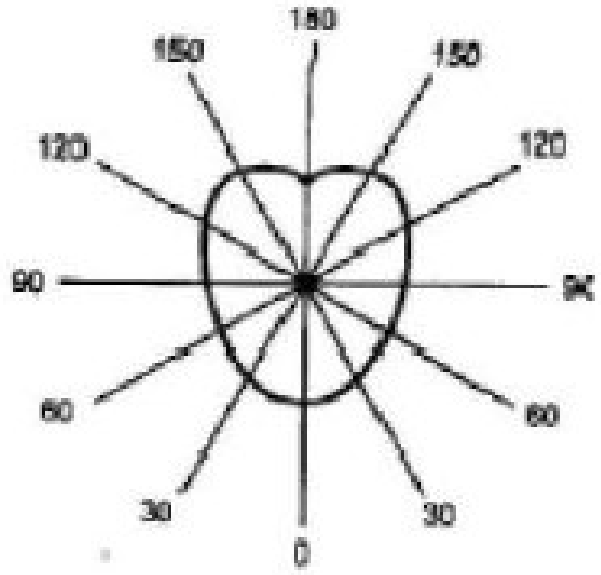
Lambert's Cosine Law

This law states that the **illumination on any surface is proportional to the cosine of angle between the direction** of the incident flux and perpendicular to the area. $E = \frac{I \cos \alpha}{d^2}$

Polar Curves

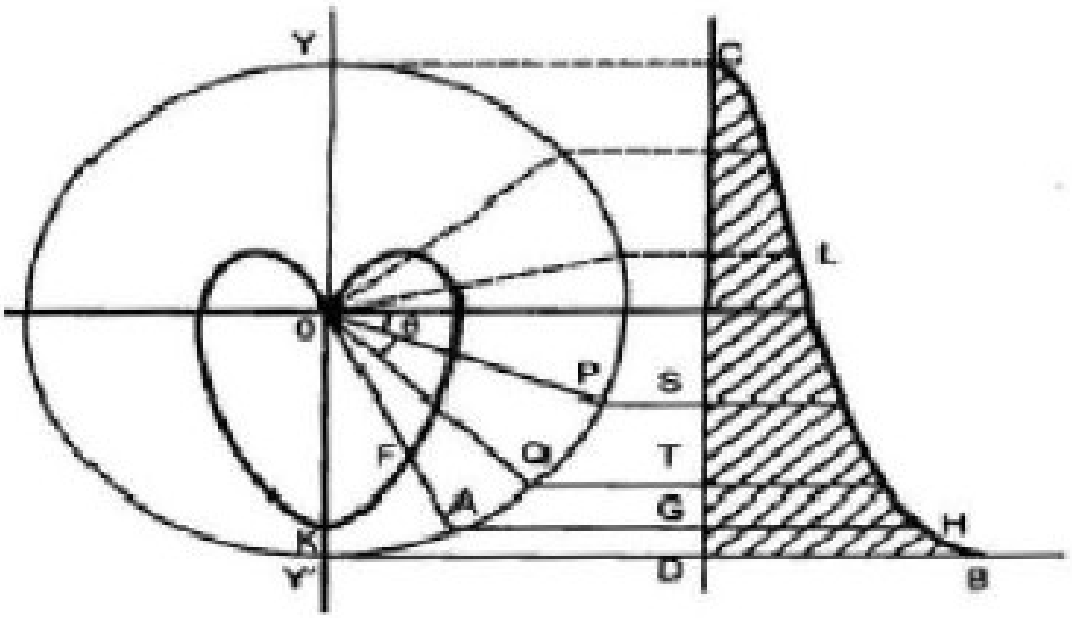


Horizontal Polar curve



Vertical Polar curve

Rousseau's Construction



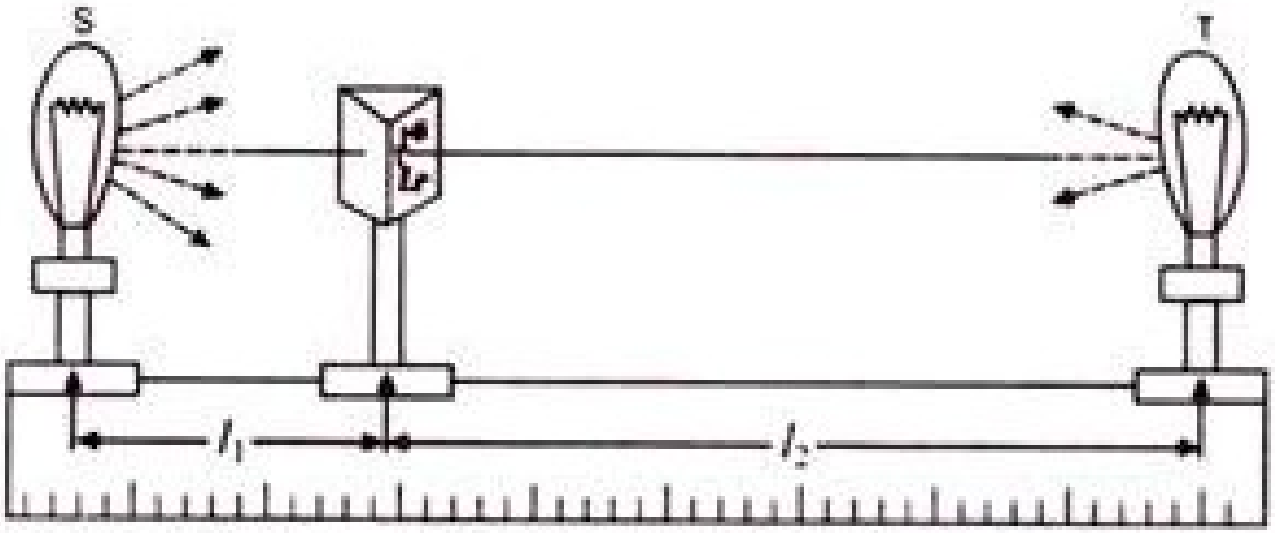
Photometry

It is a science of measurement of light

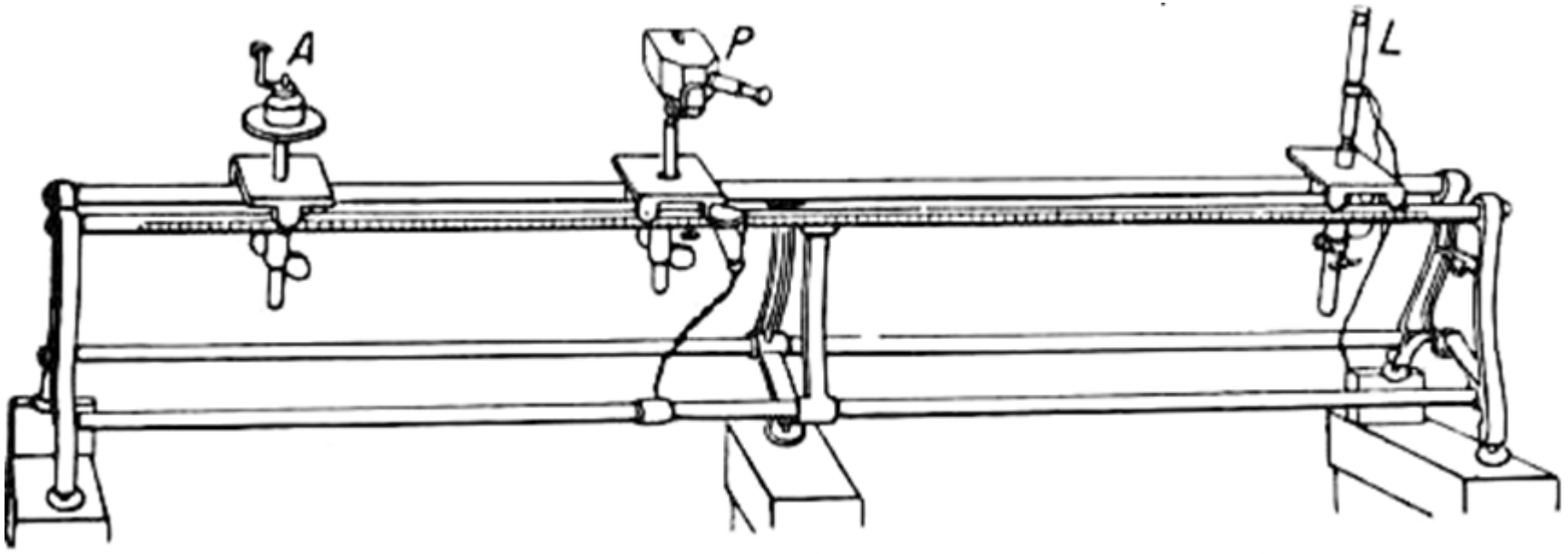
The photometers which are most common are

- Bunsen Grease Spot Photometer head
- Lummer brodhen Photometer
    - i) Equality of brightness type
    - ii) Contrast type

•To measure the candle power of the lamp. Typical measurement can be done using a photometric bench shown in Fig. below.
•where I^S represents standard lamp. I^X represents test lamp.
•There is a screen at the centre called photometer head, adjusted for equal brightness on either side.
•Applying inverse law one can arrive at the value of I^X.
This introduced the primary standard and other terminology related to measurement of light flux.

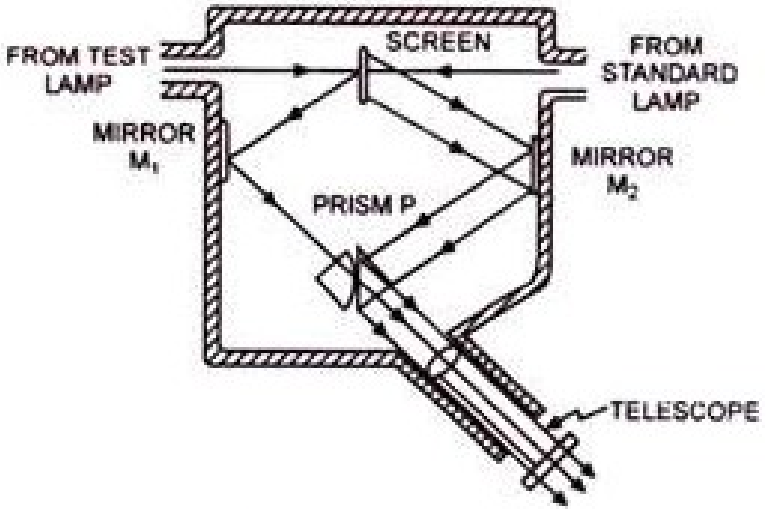


Measurement of Candle Power



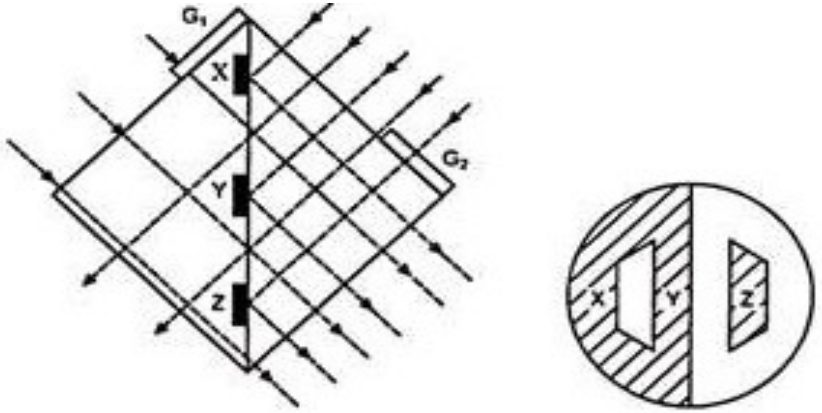
Photometer bench (*A* Hefner lamp, *P* photometer head, *L* lamp

Equality
of brightness Type



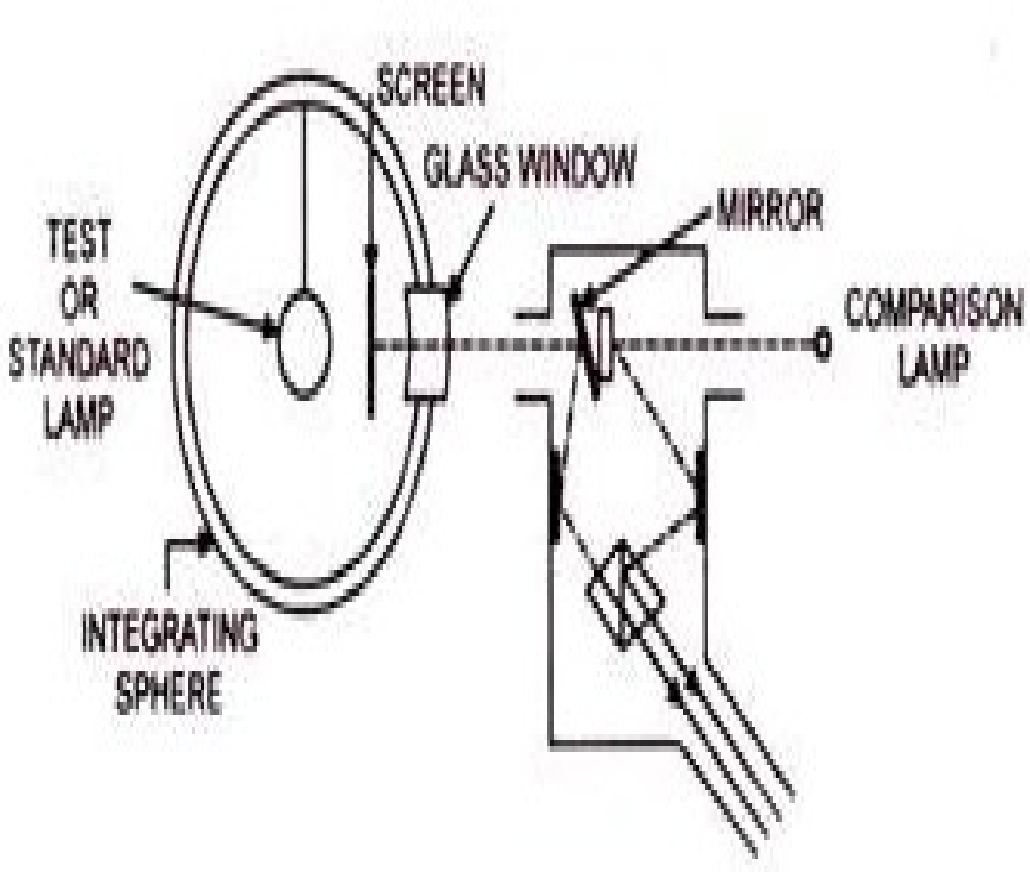
- ***Lummer Broadhun Photometer***
(Quality of Brightness Type)

Contrast Type



. Lummer Brodhun Photometer Head (Contrast Type)

Integrating Sphere



Light sources

- Arc lamps(Electric discharge through air provides intense light)
- High temperature lamps(emit light when heated to high temperature)
- Gaseous discharge lamps(passing electric current through a gas or metal vapour accompanied by visible radiations)
- Fluorescent type lamps(certain materials when exposed to sunlight, transform the absorbed energy into radiations of wavelength with in the visible range)

Arc lamps

- Carbon arc lamp

- Cinema projectors, search lights
- Not less than 45V
- Arc is maintained by transfer of carbon particles from one rod to another one
- Positive rod (85% of light)is made twice than that of the negative rod (10% of light and remaining 5% by air)in case dc supply and are made equal in case of ac supply.
- Requires adjustment of distance between the rods.
- Voltage required to maintain the arc is V=(39+2.8l)
- Temperature of positive rod is $3200^{o}C$ and$4000^{o}C$ and negative is $2500^{o}C$.
- Luminous efficiency is 12lumens/watt.

- Flame arc lamp

  contains 5-15% of fluoride(called the flame material) and 85-95% of carbon

  Radiates light energy efficiently

  turns into vapour along with carbon and these vapours cause a very high luminous intensities

  luminous efficiency is 8 lumens per watt

- Magnetic Arc lamps

  Positive electrode is made of copper

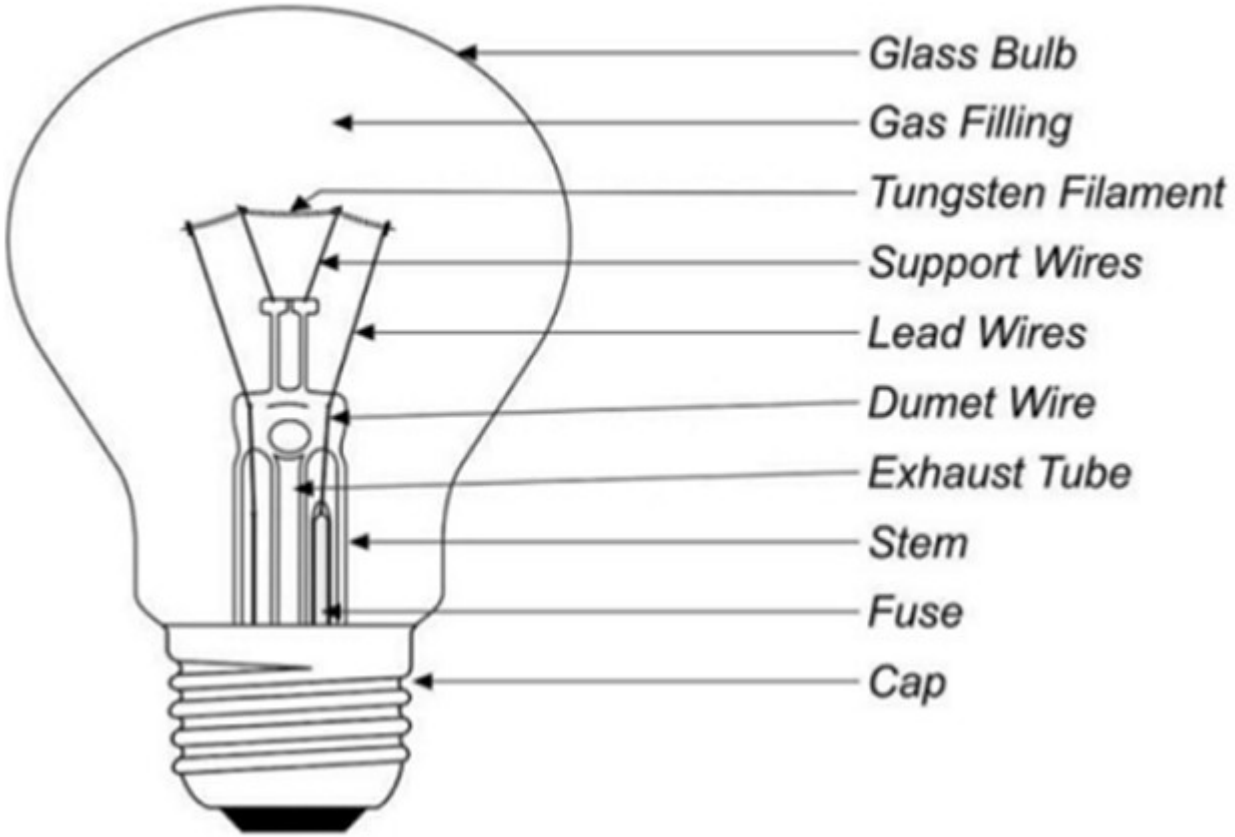
  Negative electrode is made of magnetic oxide of iron

  Lamps are rarely used.

Humphry Davy

Frederick de Moleyns

1. Incandescent Lamp. (Filament lamp) :



Incandescent—Producing a bright light after it is getting heated to a high temperature

1. It should have high melting point (3500° C).
2. It should have high resistivity.
3. It should have low temperature co-efficient.
4. It should have low vapor pressure.
5. Mechanically Strong, ductile.

Material used for filament is Carbon, Osmium tantalum and *Tungsten.*

Gas used inside the lamp (Nitrogen or Argon)

Life: 1000 Hrs working hrs. Lamp efficiency: 10 - 30 lumens/watt

- Carbon has melting point of 3500^{o}C but it gets vaporized if it is operated beyond 1800 ^{o}C and average efficiency is quite low and is of the order of 3.5 lumens/watt. It is also having the negative temperature coefficient.
- Osmium is very rare and expensive, melting point is 2600 ^{o}C and average efficiency is quite low and is of the order of 5 lumens/watt
- Tantalum has melting point of 2800 ^{o}C . Efficiency is 5 lumens/watt.
- Tungsten is the most commonly metal for filament due to its high melting point 3400 ^{o}C ,high resistivity, low temp coefficient, low vapour pressure, ductile and mechanically strong to withstand vibrations

Working:

Lamp work on the principal of Incandescence

(i.e. when a hot body is heated, radiant energy is emitted in waveform).

- An incandescent bulb generates *light* through heat.(95% Heat,5% Light)
- When electrical current passes through the tungsten filament, it heats to the point where it *glows* and gives off a yellow-red light.
- To keep the filament from burning up immediately, it's housed in a *vacuum*. Even so, the intense heat of the filament ensures a comparatively short and expensive life span.(Working avi)

Applications: Domestic, Commercial and Industrial. Etc…

Advantages

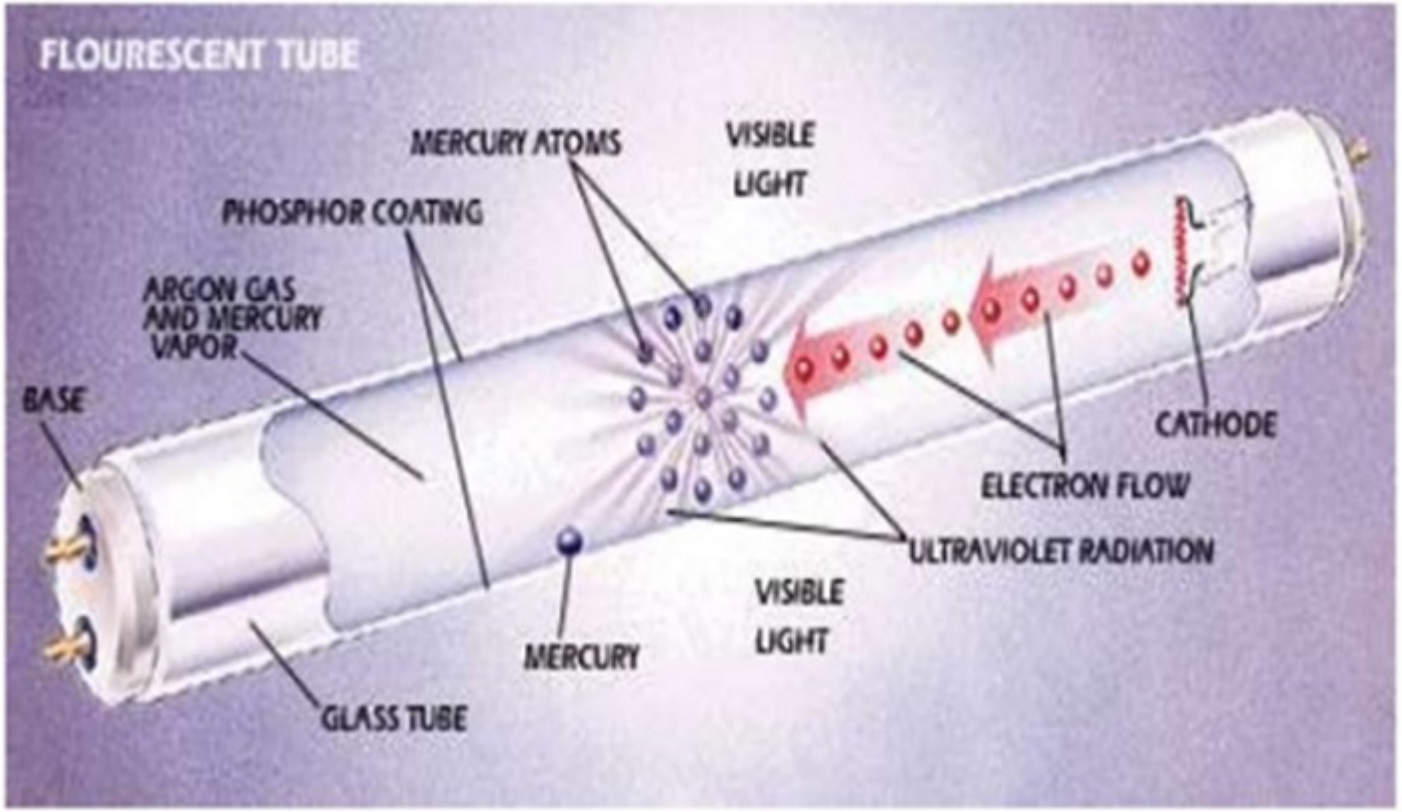
- Operating power factor unity.
- Availability in various shapes and shades.
- Good radiation characteristic in the luminous range.
- No effect of surrounding air temperature.

Gas filled lamps

- Inside gas is argon with nitrogen.
- At the center of the lamp is a tungsten filament.
- Electricity heats this filament up to about 2,500 degrees Celsius.
- Light output is 15 lumens/watt
- Operating life 1000 hour
- Efficency increased by using
  - Coiled filament
  - Coiled coil filament

2. Fluorescent Tube:

Construction:



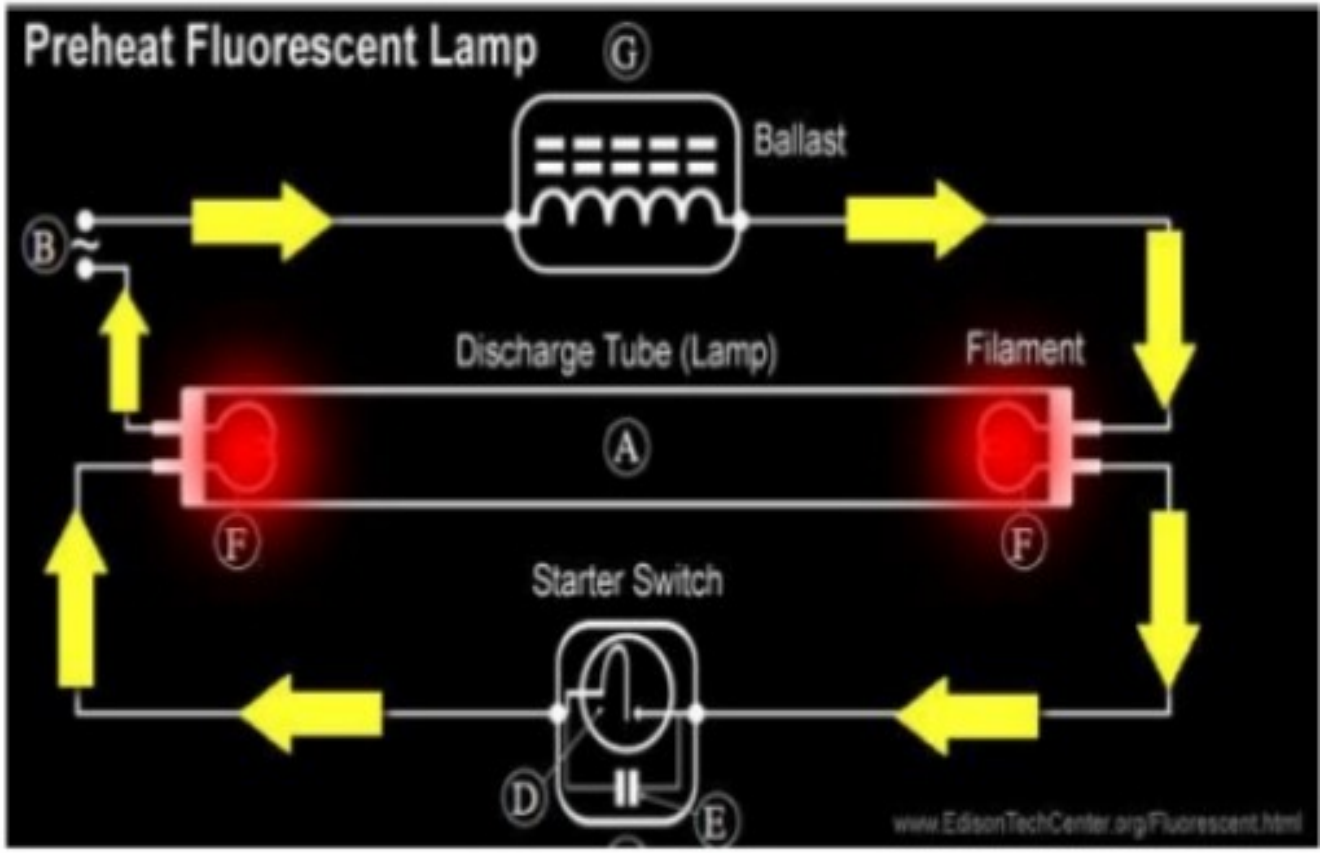
A fluorescent lamp tube is filled with a gas containing low pressure mercury vapor and argon, xenon, neon, or krypton.

The pressure inside the lamp is around 0.3% of atmospheric pressure.

The inner surface of the lamp is coated with a fluorescent (and often slightly phosphorescent) coating made of varying blends of metallic and rare-earth phosphor salts.

The lamp's electrodes are typically made of coiled tungsten and usually referred to as cathodes because of their prime function of *emitting electrons*. For this, they are coated with a mixture of barium, strontium and calcium oxides chosen to have a low thermionic emission temperature.

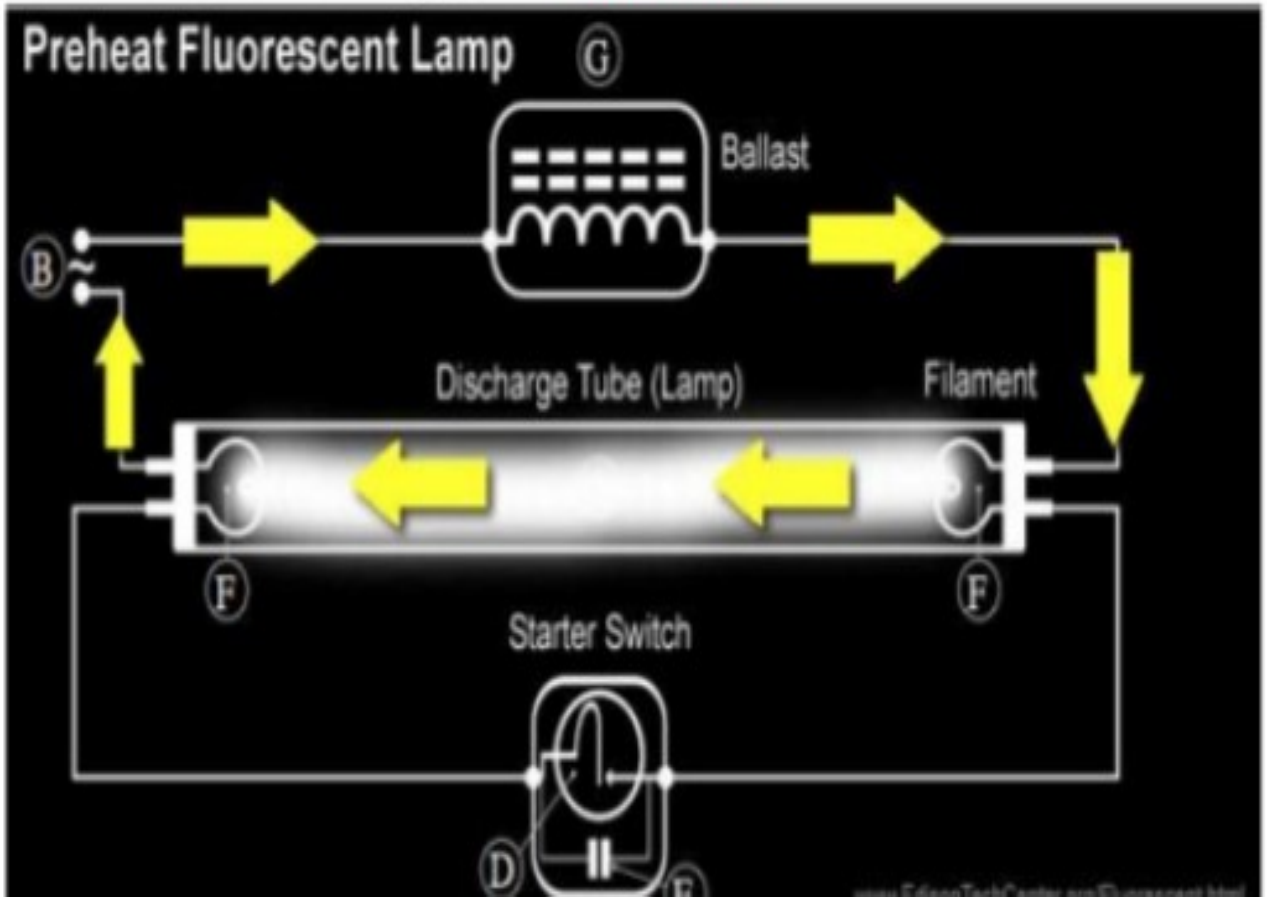
Working


Preheat Fluorescent Lamp
G
Ballast
B
Discharge Tube (Lamp)
Filament
A
F
F
Starter Switch
D
E
www.EdisonTechCenter.org/Fluorescent.html

Cathode filament emitting electrons after getting heated due to supply of current .

These electrons while accelerating collide with Argon and Mercury vapour atoms.

The excited atoms of Mercury give a radiation



Applications:

1. In US residences, fluorescent lamps are mostly found in kitchens, basements, and garages.

2. In countries, like India…

   i) Residential.

   ii) Commercial.

   iii) Small scale industries ….Etc.

3. Halogen Lamps.

Wattage: 20/50 w 12 V

300w, 500w, 1000w 230 V.

Some of them only works

Horizontal and Vertical

Efficiency- 23 to 25

lumen/watt

500 W Tungsten Halogen Lamp :

Applications:

1. Indoor lighting.
2. Outdoor lighting.
3. Flood lighting.
4. For vehicle head lights.
5. TV studios
6. Photo film.
7. Signaling.
8. Large gardens.
9. Fountains.
10. Airport runways.

Advantages

- No blackening of lamp, hence no depreciation of lumens output
- High operating temperature with increased luminous efficiency varying from 22-33 lumens/watt
- Reduced dimensions of lamps
- Long life
- Better colour rendition

Gaseous Discharge lamps

- The use of electrically excited gas discharges significantly predates the invention of the incandescent lamp
- Discharge lamps are of two types

  i)Same colour as produced by the discharge through the gas

  Ex: Sodium vapour, mercury vapour and neon gas lamps

  ii) Discharge through vapour produces ultra violet rays which cause fluorescence in certain materials like phosphor

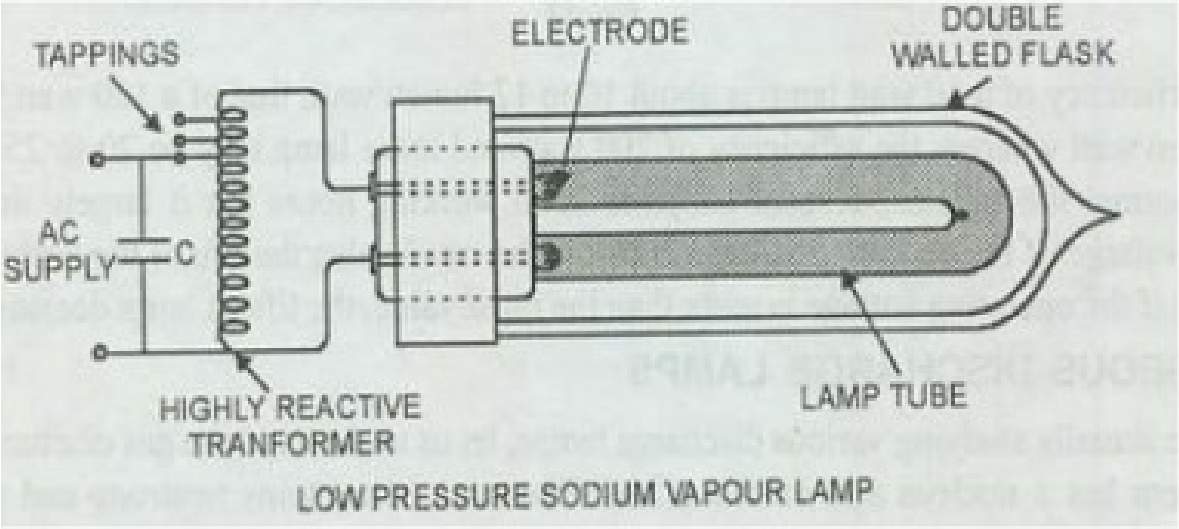
  Ex: Flouroscent mercury vapour tube

Disadvantages

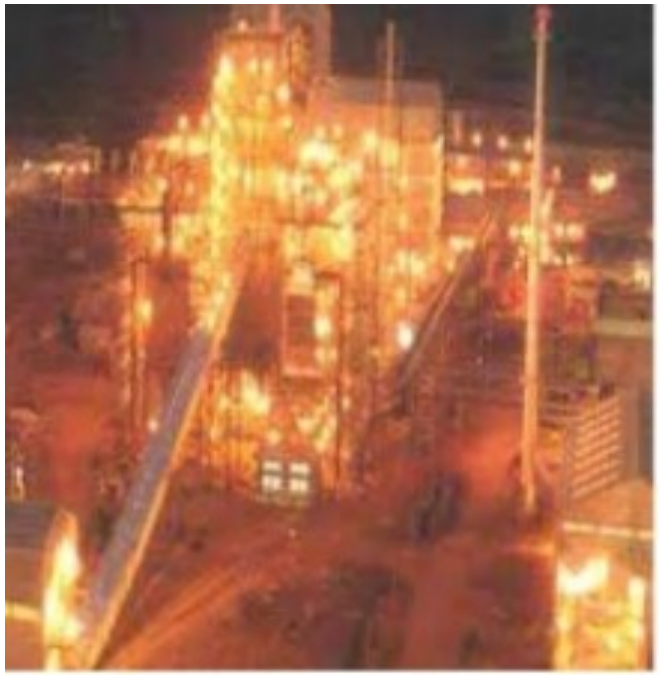
- High initial cost and low power factor
- These take time to attain full brilliancy
- Light output fluctuates at twice the supply frequency
- These lamps can be used only in particular position.
- Requires starters

Sodium vapour lamp

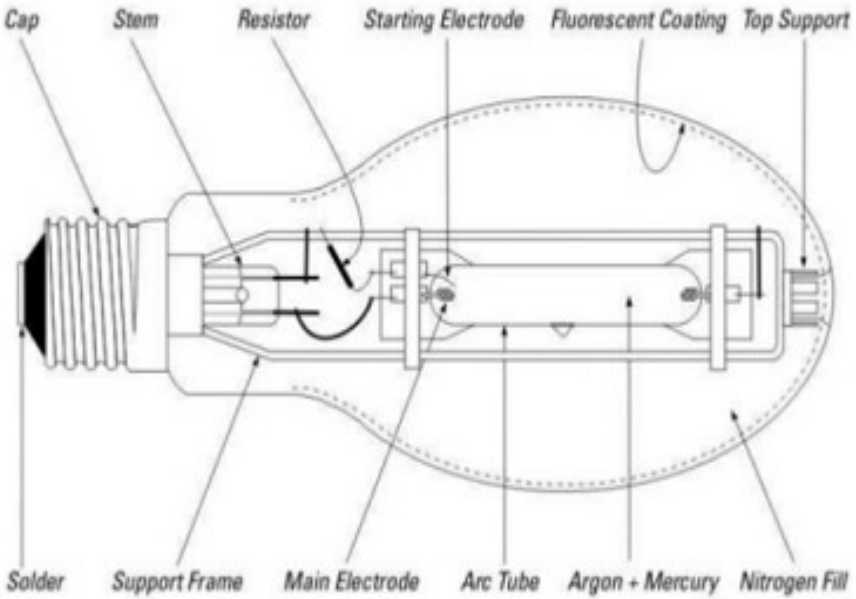
- Power factor is around 0.3-0.4
- The lamp operates at a temperature of 300^0C.
- The lamp must be operated horizontally.
- It is suitable only for AC(45,60,85 and 140 watt)
- Efficiency is about 40-50 lumens /watt.
- The average life is about 3000hrs.
- The period of light is reduced to 15% due to aging



Applications



High pressure mercury vapour lamp



- These lamps must be operated vertically
- It requires 4-5 min to attain full brilliancy.
- The temperature of inner bulb is around $600^{0}C$.
- Efficiency is about 30-40 lumens /watt.
- Used on both AC and DC(300 and 500 watt)

Lamp Type	(Lumens per Watt)	Rated Average Life (hours)
Incandescent	10 to 35	1,000 to 4,000
Mercury Vapour	20 to 60	24,000+
Light Emitting Diode	20 to 40	**50,000 to 100,000**
Fluorescent	40 to 100	6,000 to 24,000
Metal Halide	50 to 110	6,000 to 20,000
High Pressure Sodium	50 to 140	24,000 to 40,000
Low Pressure Sodium	100 to 180	16,000

Basic principles of light control

Two basic types of reflection

(i)Mirror or Specular reflection

(ii)Diffuse reflection

Types of Lightning schemes

(i)Direct Lightning(more than 90%)

causes hard shadows and glare

used for industrial and general outdoor lightning

(ii)Semi-direct lightning(60%-90%)

suited to rooms with high ceilings

Glare is avoided by diffusing globes

(ii)Semi-indirect lightning(60%-90%)

Soft Shadows, Glare free

used for indoor lightning purposes.

(iii)Indirect lightning(more than 90%)

inverted or bowl reflectors are used, glare is reduced, Shadows are less prominent. Used for decoration purposes in theaters, hotels etc.,

(iv)General lightning

Lamps made of diffusing glass are used which gives equal illumination in all directions

Design of lightning schemes

The lightning schemes should such that it

(i)provide adequate illumination.

(ii)provide light distribution all over the working plane as uniform as possible.

(iii)provide light of suitable colour and

(iv)avoid glare and hard shadows as far as possible.

1.Illumination level

2.Uniformity of illumination

3.Colour of light

4.Shadows

5.Glare

6.Moutain height

7.Spacing of luminaries

8.Colour of surrounding walls

Street Lightning

Main objectives are

(i) To make the traffic and obstructions on the road clearly visible

(ii)To make street more attractive

(iii)To increase the community value of the street

Projectors are classified as

Narrow angle(12-25)

Medium angle (25-40)

Wide angle(40-90)

Flood Lightning

- Aesthetic flood lightning
- Industrial and commercial
- Advertising

Comparison between Tungsten filament lamp and Flourescent tubes

Tungsten Filament Lamp	Fluorescent Tube
It's light is close to the natural light.	It's light is not close to natural light.
Actual colour can be judged.	Actual colour can not be judged.
Initial cost is low.	Initial cost is high.
Life is about 1000 Hrs.	Life is about 4000 Hrs.
Maintenance cost is more.	Maintenance cost is low.
Brightness is more.	It's light is cool and pleasant.
Light output is reduced with time.	It also reduces but very less.
Heat radiation loss is there.	As the temperature is less, and hence less radiation.
Less Lumen output/watt.	More Lumen output/watt (it is 40 lumen/watt).
Lumen efficiency is poor due to coloured glass etc. in case	The colour of light depends upon the gas.
No stroboscopic effect.	It has stroboscopic effect.

ELECTRIC TRACTION

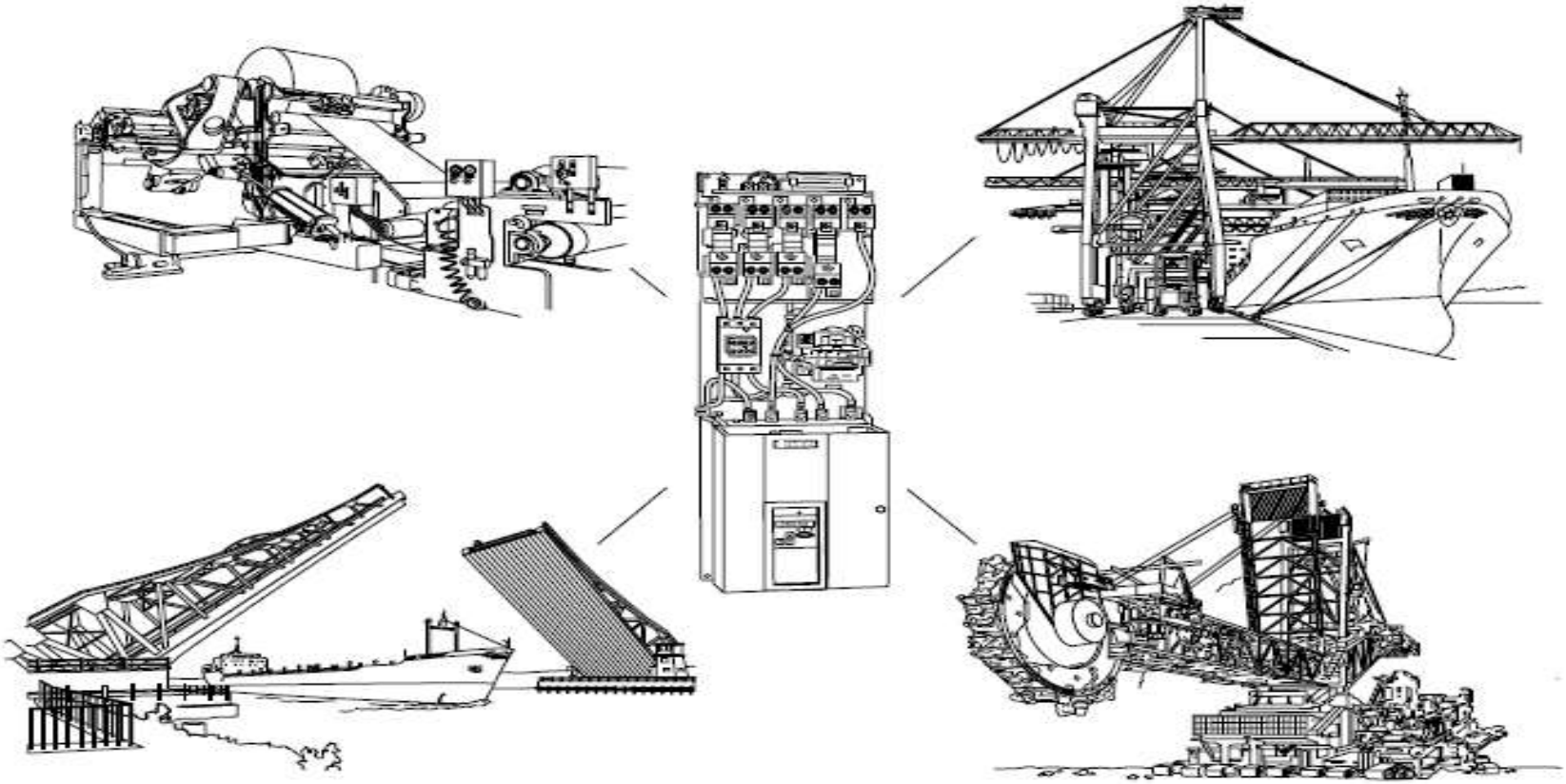
INTRODUCTION:

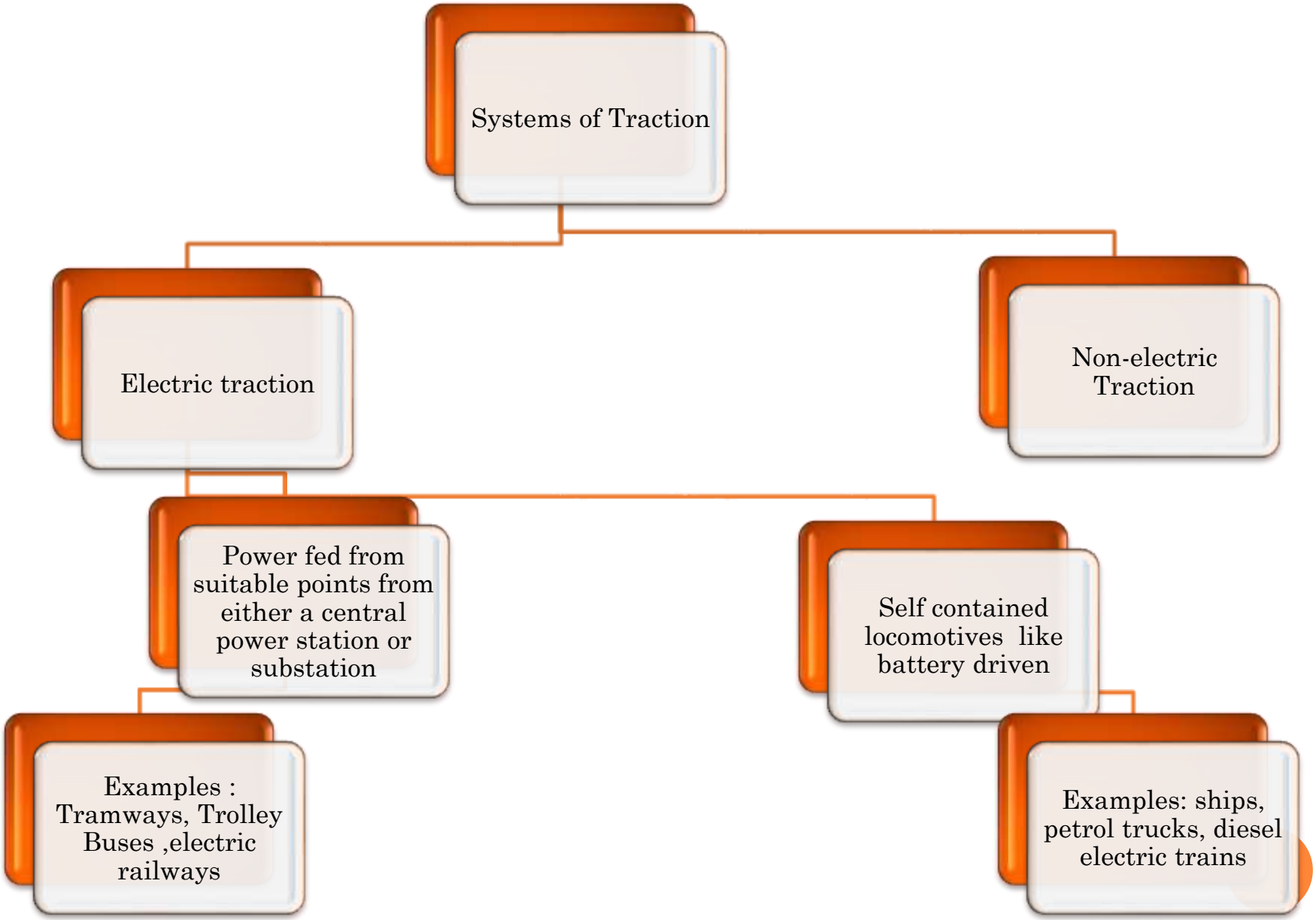
- “ACT of DRAWING "or “State of Being Drawn”

or “propulsion of vehicle” is called Traction

- The system of traction involving the use of Electricity is called Electric Traction System(ETS)
- The locomotion in which the driving force is obtained from electric motor is called the electric traction system.

Electric traction system




Systems of Traction
Electric traction
Non-electric Traction
Power fed from suitable points from either a central power station or substation
Self contained locomotives like battery driven
Examples : Tramways, Trolley Buses ,electric railways
Examples: ships, petrol trucks, diesel electric trains

MAJOR CLASSIFICATIONS OF TRACTION

- Non-electric traction:

  examples

  steam engine drive

  ic engine drive

- Electric traction:

  examples

  diesel electric drive

  gas turbine electric drive

Advantages of non- electric Traction

- Simplicity in design
- Ease of speed control
- No interference with communication network
- Low capital cost as no track electrification

BUT,,,,,,,,,,THERE ARE DISADVANTAGES

- Steam engine system is available for haulage for about 60% of its working time, the remainder of time being spent in preparing service and maintenance
- Thermal efficiency is low
- Corrosion of steel structures due to smoke emitted by engine
- Air pollution
- Low co-efficient of adhesion(power developed to the weight of engine)…not suitable for sub-urban and urban areas….

WHAT IS ELECTRIC TRACTION?



- Electric traction is meant for locomotion in which the driving (tractive) force is obtained from electric motors (called as traction motors).
- It involves utilization of electric power for traction systems i.e., for railways, trams, trolleys etc.
- For traction purposes mostly 3-Phase Induction motors and d.c series motors are used and both have high starting torque, prevailing requirement for the high speed acceleration.

A Brief History To Electric Traction

- The year 1881 saw the birth of the first electric Railway run by a German Engineer Werner Van Siemens using both the rails to carry the current. Finding this a little too dangerous, Siemens soon adopted the overhead electric wires.
- Electric traction was introduced on Indian Railways in year 1925 on 1.5 KV DC and the first electric train ran between Bombay's Victoria Terminus and Kurla along the Harbour Line of CR, on February 3, 1925, a distance of 9.5 miles, flagged off the then Governor of Bombay Sir Leslie Orme Wilson.
- The first actual train run (apart from trial runs) using 25kV AC was on December 15, 1959, on the Kendposi-Rajkharswan section (SER).
- In the year 1957, Indian Railways decided to adopt 25 kV 50 Hz AC traction based on French Railway (SNCF) technology.
- The Mumbai region is the last bastion of 1500V DC (negative earth, positive catenary) electrified lines on Indian Railways. Soon, this region too will be converted to 25KV AC with overhead lines, which is the standard throughout the rest of the country.

First AC Locomotive

- Italian Railways were the first in the world to introduce the electric traction.
- The world's first AC locomotive in Valtelina, northern Italy (1898–1902).
  Power supply: 3-phase 15 Hz AC, 3000 V (AC motor 70 km/h).
- It was designed by a Hungary company.
- The 106 km Valtellina line was opened on 4 September 1902.

Voltages Used For Electric Traction In India

- Typical Voltages used for electric Traction are 1.5kV DC and 25kV AC for mainline trains.
- Calcutta had an overhead 3kV DC system until the '60s.
- The Calcutta Metro uses 750V DC traction with a third-rail mechanism for delivering the electricity to the EMUs (Electric Multiple Units).
- The Calcutta trams use 550V DC with an overhead line (catenary) system with underground return conductors. The catenary is at a negative potential.
- The Delhi Metro uses 25kV AC overhead traction with a catenary system on the ground-level and elevated routes, and uses a rather unusual 'rigid catenary' or overhead power rail in the underground tunnel sections.
- Railway authorities purchases the power from the supply authorities and they give voltage supply of 132/110 KV at substation

Requirements of an ideal traction system

- The starting tractive effort should be high so as to have rapid acceleration.
- The wear on the track should be minimum.
- The equipments should be capable of withstanding large temporary loads.
- Speed control should be easy.
- Pollution free.
- Low initial and maintenance cost.
- The locomotive should be self contain and able to run on any route.

Merits of electric traction

- High starting torque.
- Less maintenance cost
- Cheapest method of traction
- Rapid acceleration and braking
- Less vibration
- Free from smoke and flue gases hence used for underground and tubular railway.

Demerits of electric traction

- High capital cost.
- Problem of supply failure.
- The electrically operated vehicles have to move on guided track only.
- Additional equipment is required for achieving electric braking and control.

Different systems of traction:

- Direct steam engine drive
- Direct IC engine drive
- Steam electric drive
- IC engine electric drive
- Petrol electric traction
- Battery electric drive
- Electric drive

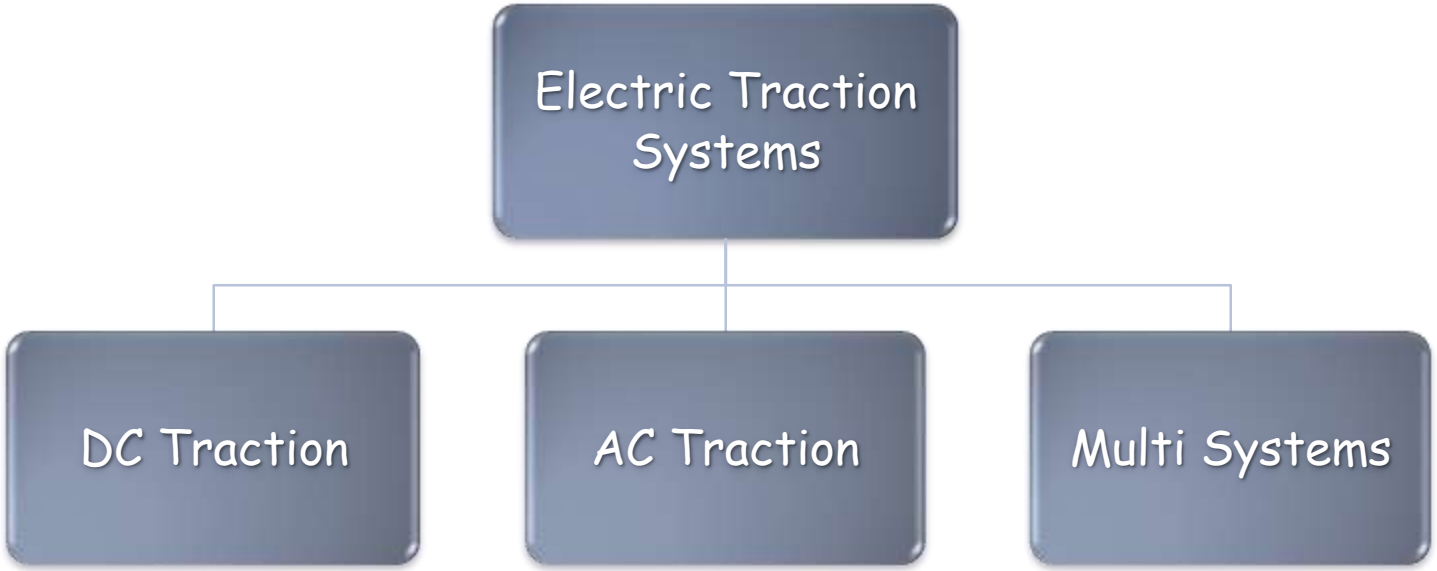
IC ENGINE ELECTRIC DRIVES

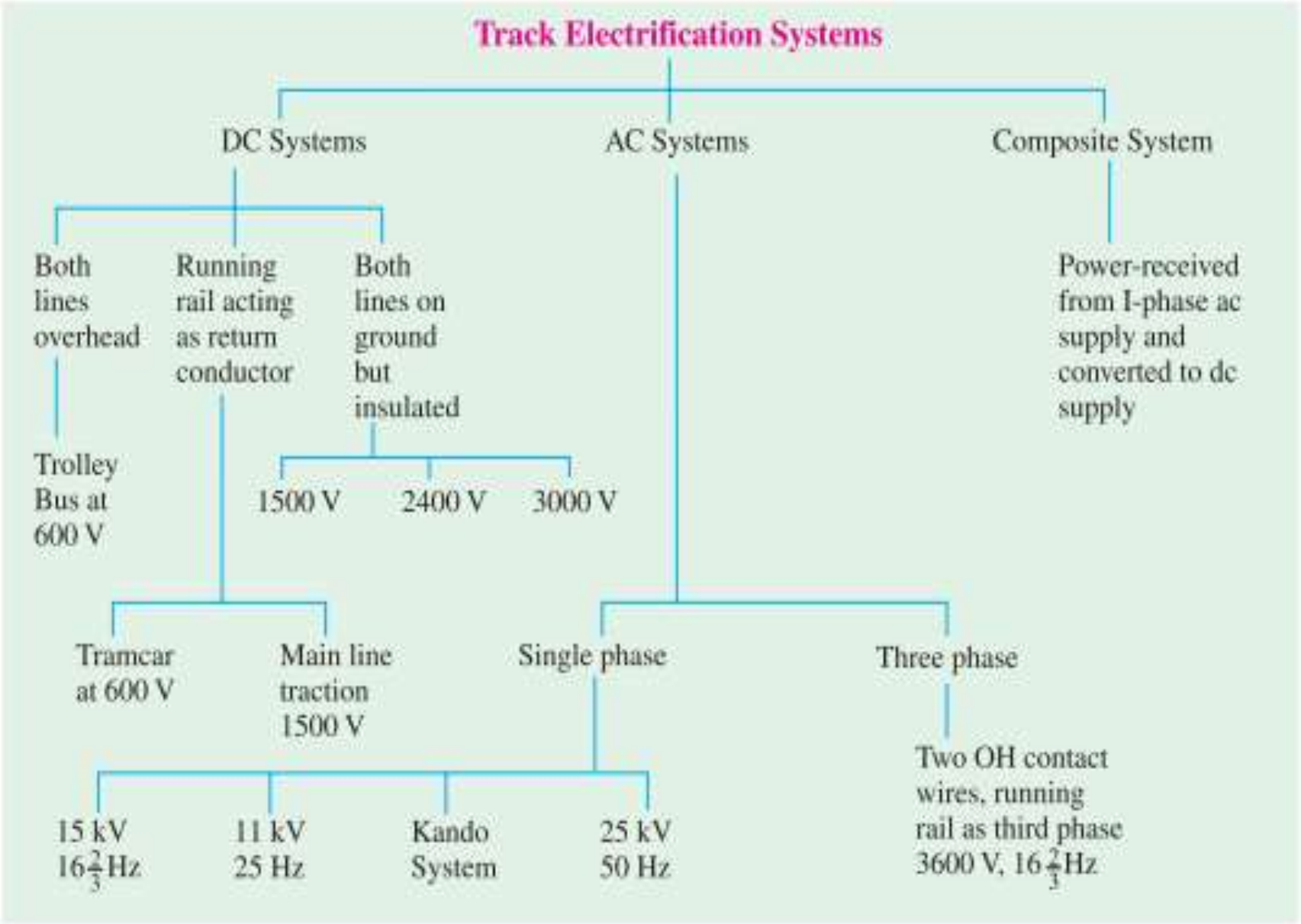
ME 05

Supply Systems for Electric traction:

- D.C system
- A.C system
  - Single phase
  - Three phase
- Composite system
  - Single phase AC to DC
  - Single phase to three phase

Types of Electric Traction Systems




Track Electrification Systems
DC Systems
AC Systems
Composite System
Both lines overhead
Running rail acting as return conductor
Both lines on ground but insulated
Power-received from I-phase ac supply and converted to dc supply
Trolley Bus at 600 V
1500 V
2400 V
3000 V
Tramcar at 600 V
Main line traction 1500 V
Single phase
Three phase
15 kV 16 2/3 Hz
11 kV 25 Hz
Kando System
25 kV 50 Hz
Two OH contact wires, running rail as third phase 3600 V, 16 2/3 Hz

DC Traction

- DC traction units use direct current drawn from either a conductor rail or an overhead line.
- The most popular line voltages for overhead wire supply systems – 1500V DC and 3000V DC.
- 600V DC–750V DC volt range used for third rail systems (a means of providing electric power to a railway train, through a semi-continuous rigid conductor placed alongside or between the rails of a railway track and that additional rail is called conductor rail)
- Disadvantages- expensive substations are required at frequent intervals and the overhead wire or third rail must be relatively large and heavy.
- The low-voltage, series-wound, direct-current motor is well suited to railroad traction, being simple to construct and easy to control.

AC Traction

- AC Traction units draw alternating current from an overhead line.
- Typical Voltages Used are:-
  - 15 kV AC, 16⅔ Hz (16.7 Hz)
  - 25 kV AC, 50 Hz
  - 25 kV AC, 60 Hz
- Fewer substations are required and the lighter overhead current supply wire can be used
- Reduced weight of support structure
- Reduced capital cost of electrification

WAG-9

Rated Power-5000 HP
Traction System- 25KV AC
Speed- 140 Km/hr
Traction Motor- DC Motor

Multi Systems

- Because of the variety of railway electrification systems, which can vary even within a country, trains often have to pass from one system to another. One way to accomplish this is by changing locomotives at the switching stations.
- These stations have overhead wires that can be switched from one voltage to another and so the train arrives with one locomotive and then departs with another.
- Often, this is inconvenient and time-consuming Another way is to use *multi-system locomotives* that can operate under several different voltages and current types.

  In Europe, it is common to use four-system locomotives (1.5 kV DC, 3 kV DC, 15 kV 16⅔ Hz AC, 25 kV, 50 Hz AC)

Advantages of AC Traction Systems

- High power-to-weight ratio than forms of traction such as diesel or steam that generate power requiring on board prime mover.
  higher power-to-weight ratio, resulting in
  - Fewer locomotives
  - Faster acceleration
  - Higher practical limit of power
  - Higher limit of speed
  - Higher hauling capability
- No exhaust fumes or carbon emissions
- Less noise pollution (quieter operation)
- The maintenance cost of an electric locomotive is nearly 50% of that for a steam locomotive. Moreover, the maintenance time is also much less.
- An electric locomotive can be started at a moment's notice whereas a steam locomotive requires two hours to heat up.
- The motors used in electric traction have a very high starting torque. Hence, it is possible to achieve higher acceleration of 1.5 to 2.5 km/h/s as against 0.6 to 0.8 km/h/s

Advantages of AC Traction Systems

- It is possible to use regenerative braking in electric traction system. It leads to the following advantages.
  - About 80% of the energy taken from the supply during ascent is returned to it during descent. And presently this returned energy is not sent back to public network but made available for other vehicles within the network
  - Goods traffic on gradient become safer and speedier.
- Since height of an electric locomotive is much less than that of a steam locomotive, its centre of gravity is comparatively low. This fact enables an electric locomotive to negotiate curves at higher speeds quite safely.
- electric trains may be powered from a number of different sources of energy (e.g. hydroelectricity, nuclear, natural gas, wind generation etc.) as opposed to diesel trains that are reliant on oil.
- electric trains do not have to carry around the weight of their fuel unlike diesel traction.
- A fully electrified railway has no need to switch between methods of traction thereby making operations more efficient. One country that approaches this ideal is Switzerland.

Disadvantages of AC Traction Systems

- Significant capital cost of electrification
- Increased maintenance cost of the lines
- Overhead wires further limit the clearance in tunnels
- Upgrading brings significant cost,

  especially where tunnels and bridges and other obstructions have to be altered for clearance
- Railway Traction needs immune power, with no cuts, warranting duplication of Transmission and Distribution systems, which obviously comes at a Premium Price.

Systems of electric traction

- **Group of vehicles which receive power from a distributing network**

  Systems operating with DC –buses, tramways and railways.

  Systems operating with AC – railways.

- **Self contained locomotives**

  Diesel-electric trains and ships

  Petrol-electric trucks and lorries

  Battery driven electric vehicles

TRAMWAYS

- Power supplied usually at 600V DC
- Provided with two driving axels.

For very dense traffic it is m

Trolley buses

- It is fed usually at 600 DC.
- No track is required
- A DC compound moto

of output 50-100KW is used.

System of Track Electrification

- Trolley wire or contact wire – suspended with minimum of sag so that contact between the trolley wire and current collector can be maintained at higher speeds.
- This wire is supported by another wire known as catenary.
  Two different types of Catenary construction can be used
  - Single Catenary
  - Compound Catenary

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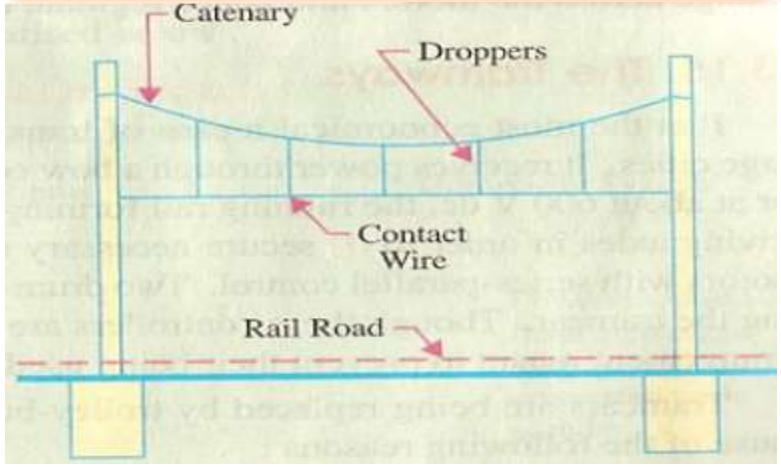
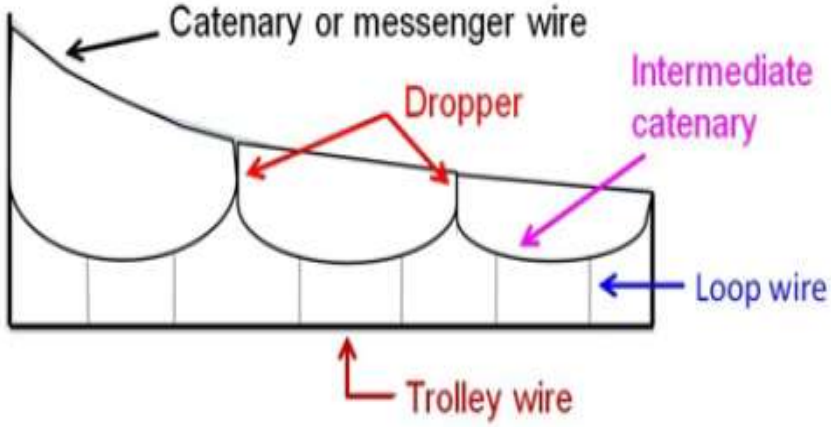
System of Track Electrification

Single Catenary Construction



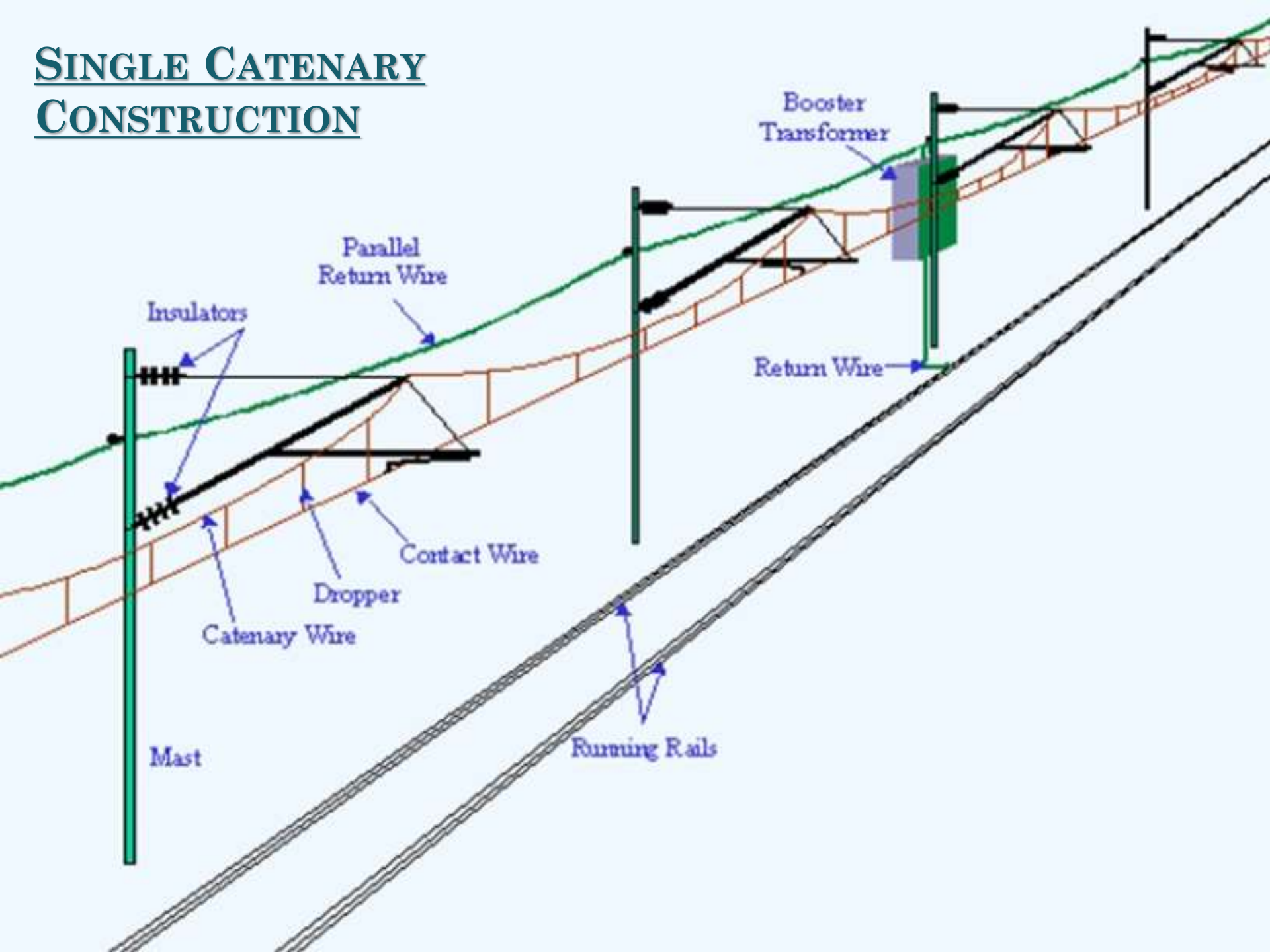
- Provided for speeds upto 120kmph
- Span of catenary wire 45-90 m
  and sag of 1-2m.
- Relatively Cheaper
- Less Maintenance
- Suitable where traffic density and operating speeds are less.

Compound Catenary Construction



- Provided for speeds ranges 190-224kmph
- Additional wire called intermediate wire is used to increase current carrying capacity i.e., to have increased traffic density.

SINGLE CATENARY CONSTRUCTION

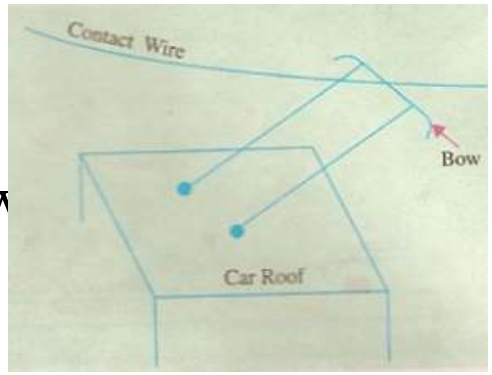


System of Track Electrification

- Current Collector- Current from the overhead wire is collected with the help of sliding contact collector mounted on the roof of the vehicle.
- Three types of Current collector-
  - Trolley Collector
  - Bow Collector
  - Pantograph Collector
- Trolley Collector- Used for Tramways and trolley buses, held in contact with Wire by spring.
- Suitable for low speeds upto 32kmph

System of Track Electrification

- **Bow Collector-** It uses a light metal strip or bow about 1 m long for current collection.
  Not suitable for railway work requiring speed of 120kmph and higher.
  Requires reversing arrangement of the bow



- **Pantograph Collector-** Main function is to maintain the link between overhead contact wire and power circuit of the locomotive at varying speeds in different climate and wind conditions
  This can be lowered or raised from cabin by air cylinders.

Traction Motors

- D.C Series Motors- Develops high torque at low speeds and low torque at high speed, exact requirement of the traction units.
  Torque is independent of the line voltage and thus unaffected by the variations in the line voltage.
- Single phase A.C Series Motors- Starting torque is lower than dc series motor due to poor power factor at starting
  This motor has surpassed the d.c series motor in terms of size, weight cost for the same rating.
  Maximum operating voltage is limited to 400 Volts.
- Three Phase Induction Motors- Provides constant speed operation, developing low starting torque drawing high starting current and complicated control networks makes it unsuitable for electric traction work.
  Automatic regeneration is the main advantage in electric traction with this

Train Lightning/Air Conditioning(TL/AC)

- Individual coaches are powered by axle-driven generators which charge storage batteries that power lights, fans and other electrical fittings.
- Older coaches use banks of 24V batteries while 110V in newer coaches.
- For powering air-conditioning equipment, an inverter was used to convert the DC output of a set of batteries to 415V AC. For some time now, however, groups of 110V alternators delivering 18-22kW each have been used to power air-conditioning equipment (the voltage is stepped up to 415V).
- In Many air-conditioned coaches, a 'mid-on generator' (MOG) is used; this is a 415V 3-phase alternator (either in one of the coaches or in a separate 'power-car'), the output from which is used both for the air-conditioning, and (stepped down to 110V) for the

Leading Traction System

- Now a days magnetic traction is being used in bullet trains (also called as 'Shinkansen'- high speed network of railway lines) operated by four Japan Railways Group Companies, comprising over 2400 km of lines with max. speeds of 240-300km/h.
- Test runs have reached 443 km/h (275 mph) for conventional rail in 1996, and up to a world record 581 km/h (361 mph) for maglev trainsets in 2003.
- Uses a 25,000 V AC overhead power supply.
- Annual Passenger traffic of over 300 million per year with an economic impact of ¥500 billion per year.
- Shinkansen's average arrival time was within six seconds of the scheduled time including all natural and human accidents and errors.
- Shinkansen trains are electric multiple unit style, offering high acceleration and deceleration.
- The Shinkansen employs an ATC (Automatic Train Control) system, manages all train operations, and all tasks relating to train movement, track, station and schedule are networked and computerized.

A Glimpse on Indian Railways

- 4th largest network in the world, with 16 Zones, transporting over 10 billion passengers and over 1050 million tonnes of freight annually.
- IR employs about 1.6 million people, making itself the second largest commercial or utility employer in the world.
- With a view to reduce dependence on petroleu switched over electric traction. It is a pollutio system and with the use of modern high horse power locos having regenerative braking, it becomes vastly energy efficient.
- India consumes 2% of World's oil, while Indian Railway uses only 1.7% of India 's Oil. This Fact shows that how diesel traction is not very much motivated in India.

	Country	Railway Length (Km)	Electrified Length (Km)
1	United States	226,427	<1,000
2	Russia	128,000	50,000
3	China	98,000	48,000
4	India	65,000	22,224
5	Canada	46,552	129
6	Australia	38,445	2,715
7	Germany	37,679	20,497
8	Argentina	35,897	136
9	South Africa	31,000	24,800
10	France	29,901	15,140

Source: International Union of Railways

Train Movement

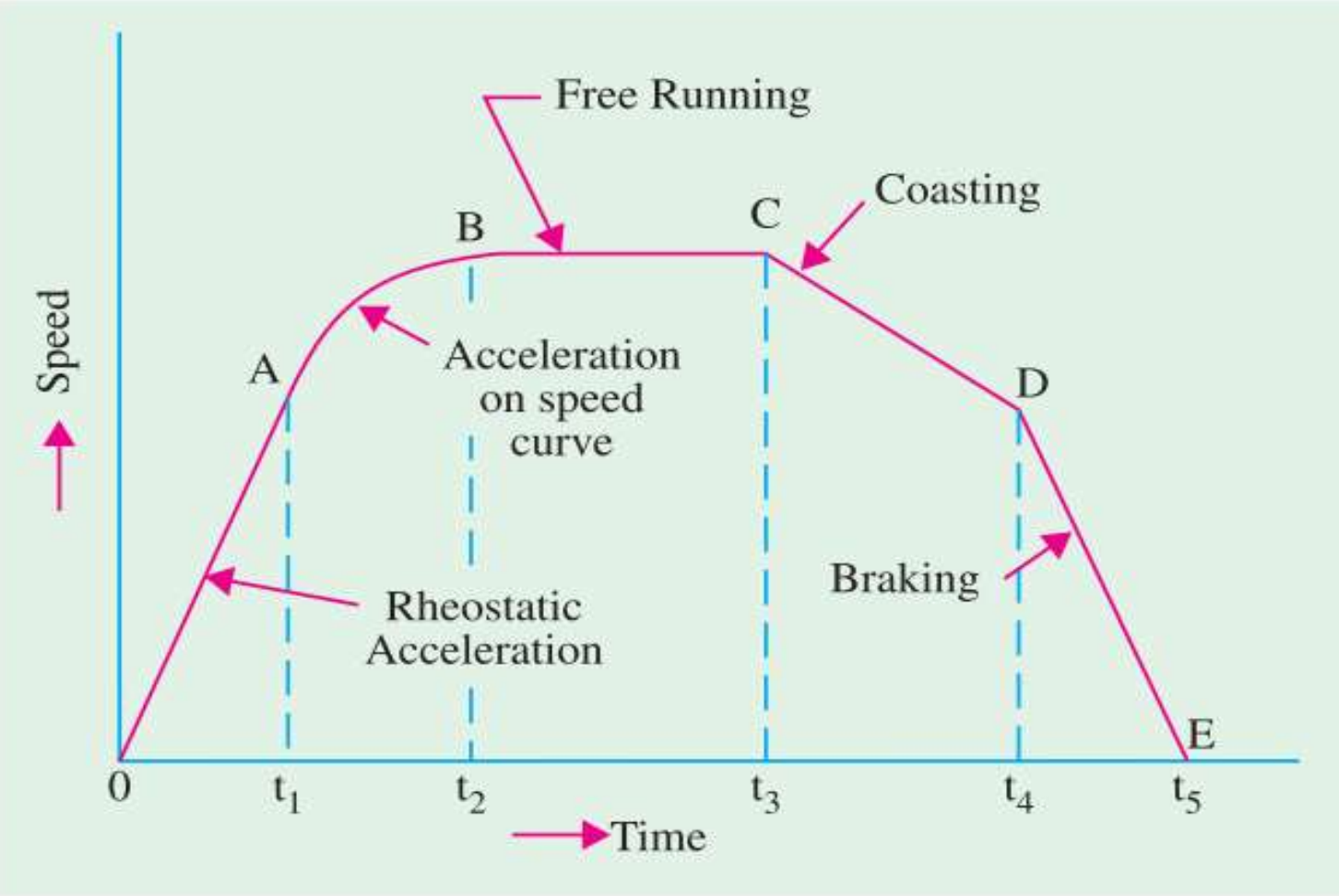
- The movement of trains and their energy consumption can be conveniently studied by means of speed/time and speed/distance curves.
- As their names indicate, former gives speed of the train at various times after the start of the run and the later gives speed at various distances from the starting point.
- Out of the two, speed/time curve is more important because

1. its slope gives acceleration or retardation as the case may be.
2. area between it and the horizontal (i.e. time) axis represents the distance travelled.
3. energy required for propulsion can be calculated if resistance to the motion of train is known.

TYPICAL SPEED TIME CURVE FOR TRAIN MOVEMENT

- Acceleration
  - Constant acceleration
  - Speed curve running
- Free run or constant speed period
- Coasting period
- Retardation or braking period

Typical speed /time curve



Constant Acceleration Period (0 to t1):

- It is also called notching-up or starting period because during this period, starting resistance of the motors is gradually cut out so that the motor current (and hence, tractive effort) is maintained nearly constant which produces constant acceleration alternatively called ‘rheostatic acceleration’ or ‘acceleration while notching’.

Acceleration on Speed Curve (t1 to t2)

- This acceleration commences after the starting resistance has been all cutout at point t1 and full supply voltage has been applied to the motors.
- During this period, the motor current and torque decrease as train speed increases. Hence, acceleration gradually decreases till torque developed by motors exactly balances that due to resistance to the train motion.
- The shape of the portion AB of the speed/time curve depends primarily on the torque/speed characteristics of the traction motors.

Free-running Period (t2 to t3)

- The train continues to run at the speed reached at point t 2 . It is represented by portion BC in Fig. and is a constant-speed period which occurs on level tracks.

Coasting (t3 to t4)

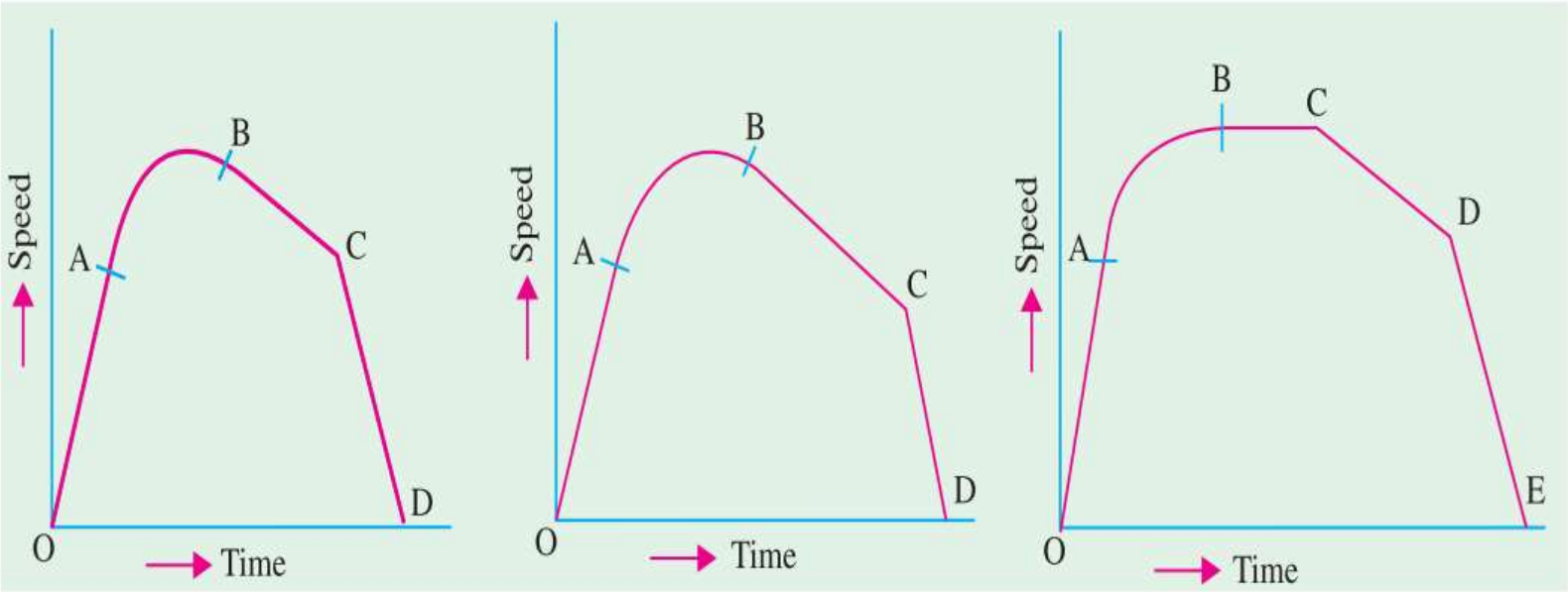
- Power to the motors is cut off at point t3 so that the train runs under its momentum, the speed gradually falling due to friction, windage etc. (portion CD).
- During this period, retardation remains practically constant.
- Coasting is desirable because it utilizes some of the kinetic energy of the train which would, otherwise, be wasted during braking.
- Hence, it helps to reduce the energy consumption of the train.

Braking (t4 to t5)

- At point t4 , brakes are applied and the train is brought to rest at point t5 .
- It may be noted that coasting and braking are governed by train resistance and allowable retardation respectively.

Typical speed time curves for different services

- Urban or city services
- Sub urban services
- Main line services



TYPES OF SPEED IN TRACTION

- **Crest speed**: It is the maximum speed (Vm) attained by a train during the run

- **Average speed**: Ratio of distance between stops to that of actual time of run

In this case, only running time is considered but not the stop time

- **Schedule speed**: Ratio of distance between stops to that of actual time of run + stop time

Tractive Effort for Propulsion of a Train

- The tractive effort (*Ft*) is the force developed by the traction unit at the rim of the driving wheels for moving the unit itself and its train (trailing load). The tractive effort required for train propulsion on a *level track* is

$$Ft = Fa + Fr$$

- If gradients are involved, the above expression becomes

$$Ft = Fa + Fg + Fr \text{ — for ascending gradient}$$

$$Fa - Fg + Fr \text{ — for descending gradient}$$

Where

Fa = force required for giving linear acceleration to the train

Fg = force required to overcome the effect of gravity

Fr = force required to overcome resistance to train motion.

Value of Fa

- If M is the dead (or stationary) mass of the train and a its linear acceleration, then

$$Fa = Ma$$

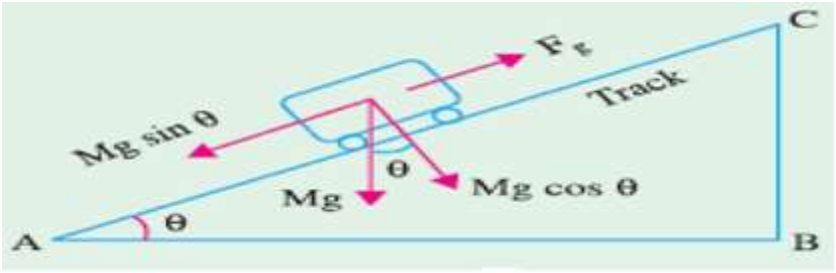
- Since a train has rotating parts like wheels, axles, motor armatures and gearing etc., its *effective* (or accelerating) mass Me is more (about 8 – 15%) than its stationary mass.
- These parts have to be given angular acceleration at the same time as the whole train is accelerated in the linear direction.

$$\text{Hence, } Fe = Mea$$

- If Me is in tonne and α in km/h/s, then converting them into absolute units, we have

$Fa = (1000\ Me) \times (1000/3600)\ a = 277.8\ Me\ a$ newton

VALUE OF FG



$Fg = W \sin \theta = Mg \sin \theta$

- In railway practice, gradient is expressed as the rise (in metres) a track distance of 100 m and is called percentage gradient.

Therefore $\% G = BC / AC * 100 = 100 \sin \theta$

Substituting the value of sin θ in the above equation, we get

$$Fg = Mg\ G/100 = 9.8 \times 10{-}2\ MG$$

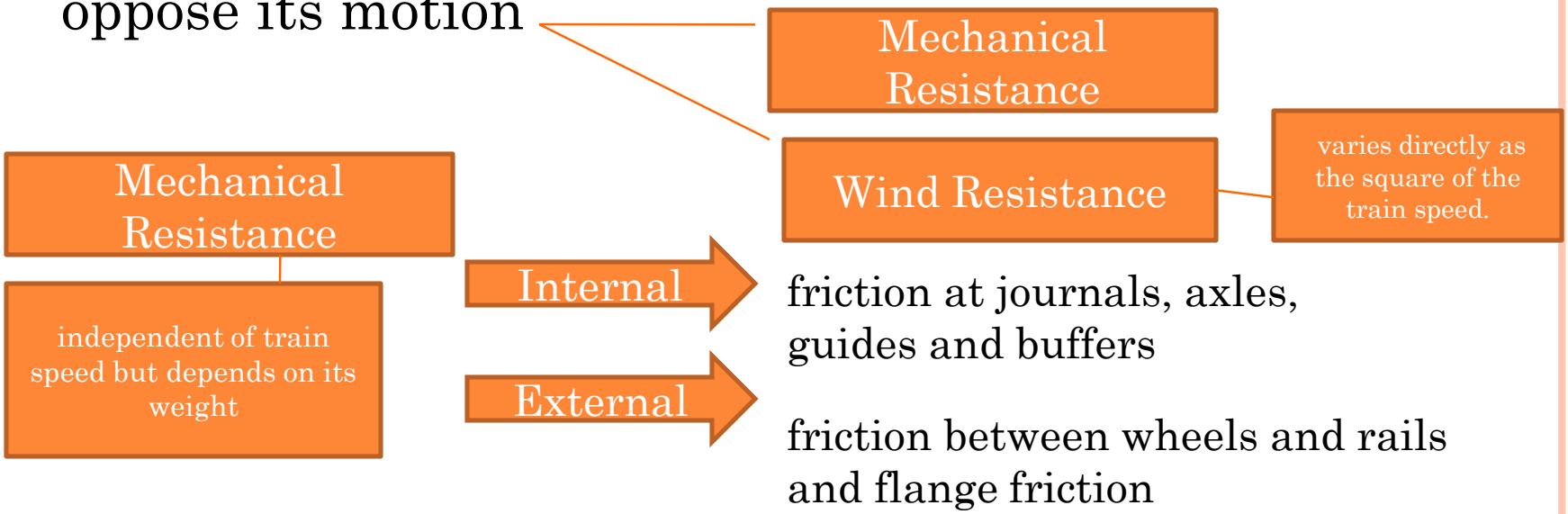
- When M is in kg, $Fg = 9.8 \times 10{-}2\ MG$ newton

- When M is given in tonne, then

$Fg = 9.8 \times 10{-}2\ (1000\ M)\ G = 98\ MG$ Newton

Value of Fr

- Train resistance comprises all those forces which oppose its motion



r is specific resistance of the train *i.e.* resistance offered per unit mass of the train, then

$$Fr = M.r.$$

- **(i)** If r is in newton per kg of train mass and M is the train mass in kg, then

$$Fr = M.r \text{ newton}$$

- **(ii)** If r is in newton per tonne train mass (N/t) and M is in tonne (t), then

$$Fr = M \text{ tonne} \times r = Mr \text{ newton*}$$

Hence, expression for total tractive effort becomes

$$Ft = Fa \pm Fg + Fr$$

$$= (277.8\ \alpha\ Me \pm 98\ MG + Mr) \text{ newton}$$

- Please remember that here M is in tonne, α in km/h/s, G is in metres per 100 m of track length (*i.e.* % G) and r is in newton/tonne (N/t) of train mass.
- The positive sign for Fg is taken when motion is along an ascending gradient and negative sign when motion is along a descending gradient.

Power Output from Driving Axles

- If Ft is the tractive effort and v is the train velocity, then

$$\text{output power} = Ft \times \text{v}$$

- If Ft is in newton and v in m/s, then

$$\text{output power} = Ft \times \text{v watt}$$

- If Ft is in newton and v is in km/h , then
-

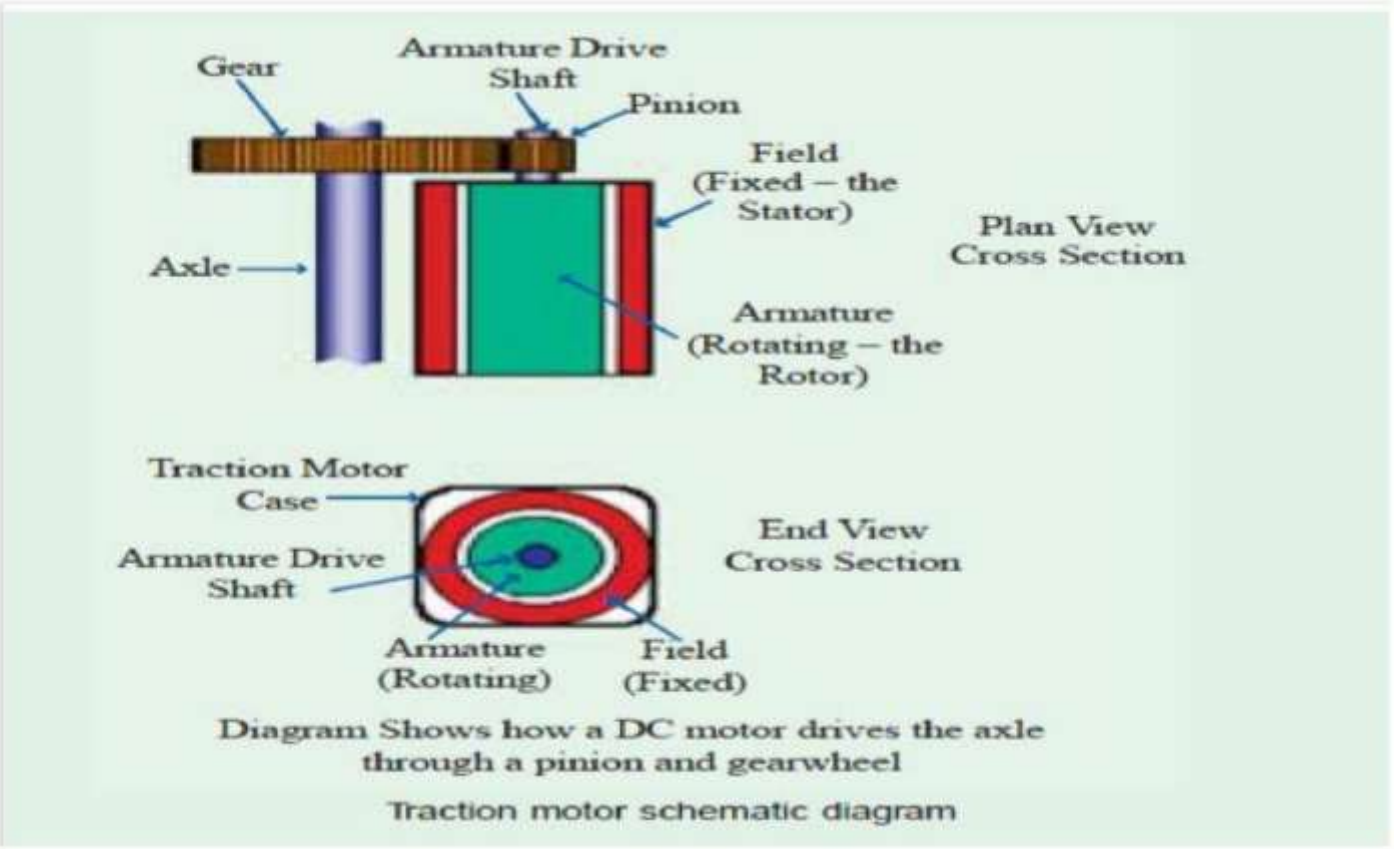


Diagram Shows how a DC motor drives the axle through a pinion and gearwheel

Traction motor schematic diagram

$$\text{output power} = F_t \times \left(\frac{1000}{3600}\right) v \text{ watt} = \frac{F_t\, v}{3600} \text{ kW}$$

If η is the efficiency of transmission gear, then power output of motors is

$$= F_t \,.\, v/\eta \text{ watt} \qquad \text{— } v \text{ in m/s}$$

$$= \frac{F_t\, v}{3600\, \eta} \text{ kW} \qquad \text{— } v \text{ in km/h}$$

Energy Output From Driving Axles

- Energy (like work) is given by the product of power and time

$$E = F_t * V * t = F_t * D$$

Where

D is the distance travelled in the direction of tractive effort, F_tTotal energy output from the driving axles for the run is, assuming trapezoidal speed-time curve.

E = energy during acceleration + energy during free run

$$= 1/2\ F_t V_m t_1 + F_t V_m t_2$$

Where

V_m is the maximum or crest speed in m/s,

t_1 is the time of acceleration in seconds and

t_2 is the time of free run in seconds.

F_t is the effort required during acceleration in newtons and F'_t is the effort required during free run in newtons.

Specific Energy Output

- It is the energy output of the driving wheel expressed in watt-hour (Wh) per tonne-km (t-km) of the train. It can be found by first converting the energy output into Wh and then dividing it by the mass of the train in tonne and route distance in km.
- Hence,

unit of specific energy output generally used in railway work is

: Wh/tonne-km (Wh/t-km).

Evaluation of Specific Energy Output

- First calculate the total energy output of the driving axles and then divide it by train mass in tonne and route length in km to find the specific energy output.
- It will be presumed that :

(i) there is a gradient of G throughout the run

(ii) power remains ON upto the end of free run in the case of trapezoidal curve and upto the accelerating period in the case of quadrilateral curve

- Now, output of the driving axles is used for the following purposes :

1. for accelerating the train
2. for overcoming the gradient
3. for overcoming train resistance

(A) ENERGY REQUIRED FOR TRAIN ACCELERATION (EA)

from trapezoidal diagram

$$E_a = F_a \times \text{distance } OAD = 277.8\,\alpha\, M_e \times \frac{1}{2} V_m.t_1 \text{ joules}$$

$$= 277.8\,\alpha\, M_e \times \frac{1}{2} V_m \times \frac{V_m}{\alpha} \text{ joules}$$

$$= 277.8\,\alpha\, M_e \times \left[\frac{1}{2}.\frac{V_m \times 1000}{3600} \times \frac{V_m}{\alpha}\right] \text{ joules}$$

It will be seen that since V_m is in km/h, it has been converted into m/s by multiplying it with the conversion factor of (1000/3600). In the case of (V_m /t), conversion factors for V_m and a being the same, they cancel out. Since 1 Wh = 3600 J.

$$\therefore \quad E_a = 277.8\,\alpha\, M_e \left[\frac{1}{2}.\frac{V_m \times 1000}{3600} \times \frac{V_m}{\alpha}\right] \text{Wh} = 0.01072\,\frac{V_m^2}{M_e} \text{ Wh}$$

(B) Energy required for over coming gradient (Eg)

$$E_g = F_g \times D'$$

where 'D'' is the *total distance over which power remains* ON. Its maximum value equals the distance represented by the area *OABE* in **Curves** *i.e.* from the start to the end of free-running period in the case of trapezoidal curve [as per assumption (*i*) above].

Substituting the value of F_g from **previous** we get

$$E_g = 98\ MG.\ (1000\ D')\ \text{joules} = 98{,}000\ MGD'\ \text{joules}$$

It has been assumed that D' is in km.

When expressed in Wh, it becomes

$$E_g = 98{,}000\ MGD' \frac{1}{3600}\ \text{Wh} = 27.25\ MGD'\ \text{Wh}$$

(c) Energy required for overcoming resistance (E_r)

$$E_r = F_r \times D' = M\ .\ r \times (1000\ D')\ \text{joules} \qquad \text{— } D' \text{ in km}$$

$$= \frac{1000\ Mr\ D'}{3600}\ \text{Wh} = 0.2778\ Mr\ D'\ \text{Wh} \qquad \text{— } D' \text{ in km}$$

$\therefore$ total energy output of the driving axles is

$$E = E_a + E_g + E_r$$
$$= (0.01072\, V_m^2/M_e + 27.25\, MGD' + 0.2778\, Mr\, D' \text{ Wh}$$

Specific energy output

$$E_{spo} = \frac{E}{M \times D}$$ — D is the *total* run length

$$= \left(0.01072 \frac{V_m^2}{D} . \frac{M_e}{M} + 27.25\, G \frac{D'}{D} + 0.2778\, r \frac{D'}{D} \right) \text{Wh/t-km}$$

It may be noted that *if there is no gradient*, then

$$E_{spo} = \left(0.01072 \frac{V_m^2}{D} . \frac{M_e}{M} + 0.2778\, r \frac{D'}{D} \right) \text{Wh/t-km}$$

Energy Consumption

- It equals the total energy input to the traction motors from the supply. It is usually expressed in Wh which equals 3600 J.
- It can be found by dividing the energy output of the driving wheels with the combined efficiency of transmission gear and motor.

$$\text{energy consumption} = \frac{\text{output of driving axles}}{\eta_{motor} \times \eta_{gear}}$$

Specific Energy Consumption

It is the energy consumed (in Wh) per tonne mass of the train per km length of the run.

Specific energy consumption,

$$E_{spc} = \frac{\text{total energy consumed in Wh}}{\text{train mass in tonne} \times \text{run length in km}} = \frac{\text{specific energy output}}{\eta}$$

where η = overall efficiency of transmission gear and motor = $\eta_{gear} \times \eta_{motor}$

As seen from Art. 43.41, specific energy consumption is

$$E_{spc} = \left(0.01072 . \frac{V_{m^2}}{\eta D} . \frac{M_e}{M} + 27.25 \frac{G}{\eta} . \frac{D'}{D} + 0.2778 \frac{r}{\eta} . \frac{D'}{D} \right) \text{Wh/t-km}$$

If no gradient is involved, then specific enrgy consumption is

$$E_{spc} = \left(0.01072 . \frac{V_{m^2}}{\eta D} . \frac{M_e}{M} + 0.2778 \frac{r}{\eta} . \frac{D'}{D} \right) \text{Wh/t-km}$$

- The specific energy consumption of a train running at a given schedule speed is influenced by

1. Distance between stops
2. Acceleration
3. Retardation
4. Maximum speed
5. Type of train and equipment
6. Track configuration.

Adhesive Weight

- It is given by the total weight carried on the driving wheels.

$$Wa = x\ W,$$

where W is dead weight

x is a fraction varying from 0.6 to 0.8.

DEAD WEIGHT:

The total weight of locomotive and train to be pulled by the locomotive.

ACCELERATING WEIGHT: The dead weight of the train *i.e.* the weight of locomotive and train can be divided into two parts

(i) The weight ,which requires angular acceleration such as weight of wheels, axels gears etc.,

(ii) The weight ,which requires linear acceleration

Accelerating weight is taken as 5 to10 percent more than dead weight.

Coefficient of Adhesion

- Adhesion between two bodies is due to interlocking of the irregularities of their surfaces in contact.
- The adhesive weight of a train is ***equal to the total weight to be carried on the driving wheels.*** It is less than the dead weight by about 20 to 40%.

If $x = \dfrac{\text{adhesive weight, } W_a}{\text{dead weight } W}$, then, $W_a = x\,W$

Let, F_t = tractive effort to slip the wheels

or

= maximum tractive effort possible without wheel slip

Coefficient of adhesion, $\mu_a = F_t / W_a$

$\therefore$ $F_t = \mu_a W_a = \mu_a x W = \mu_a x Mg$

If M is in tonne, then

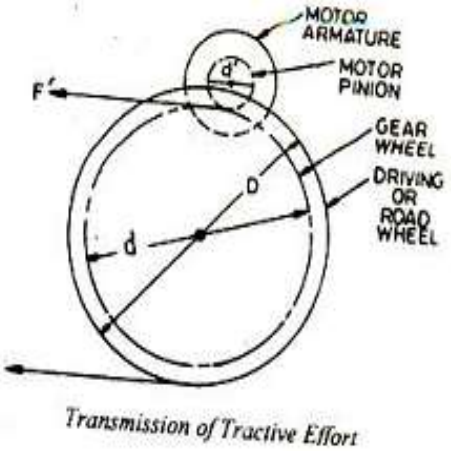
$$F_t = 1000 \times 9.8\, x\, \mu_a M = 9800\, \mu_a x\, M \text{ newton}$$

- It has been found that tractive effort can be increased by increasing the motor torque but only upto a certain point.
- Beyond this point, any increase in motor torque does not increase the tractive effort but merely causes the driving wheels to slip.
- It is seen from the above relation that for increasing Ft , it is not enough to increase the kW rating of the traction motors alone but the weight on the driving wheels has also to be increased.
- Adhesion also plays an important role in braking. If braking effort exceeds the adhesive weight of the vehicle, skidding takes place.

Mechanism of Train Movement

- The essentials of driving mechanism in an electric vehicle are illustrated.
- The armature of the driving motor has a pinion which meshes with the gear wheel keyed to the axle of the driving wheel.
- In this way, motor torque is transferred to the wheel through the gear.

- Let,
- T = torque exerted by the motor
- F1 = tractive effort at the pinion
- Ft = tractive effort at the wheel
- γ = gear ratio



Transmission of Tractive Effort

Here, d1 , d2 = diameters of the pinion and gear wheel respectively

D = diameter of the driving wheel

η = efficiency of power transmission from the motor to driving axle

Now, $T = F1 \times d1/2$ or $F1 = 2T/d1$

Here $d1 = d'$; $d2 = d$; $F' = F1$

Tractive effort transferred to the driving wheel is

$$F_t = \eta F_1 \left(\frac{d_2}{D}\right) = \eta \cdot \frac{2T}{d_1}\left(\frac{d_2}{D}\right) = \eta T \left(\frac{2}{D}\right)\left(\frac{d_2}{d_1}\right) = 2\gamma\eta\frac{T}{D}$$

TRACTION MOTOR ELECTRICAL FEATURES

- High starting torque
- Simple speed control
- Regenerative braking
- Better commutation
- Capability of withstanding voltage fluctuations.

MECHANICAL FEATURES

- Light in weight.
- Small space requirement.
- Robust and should be able to withstand vibration.

Traction motor control

- Rheostat control
- Series parallel control
- Field control
- Buck and boost method
- Metadyne control
- Thyristor control
  - Phase control
  - Chopper control

Braking

ELECTRIC BRAKING

- Plugging or reverse current braking
- Rheostatic braking
- Regenerative braking
  - DC shunt motor
  - DC series motor
  - Induction motor

MECHANICAL BRAKING

- Compressed air brakes
- Vacuum brakes

MAGNETIC TRACK BRAKES