KKR & KSR INSTITUTE OF TECHNOLOGY & SCIENCES

(Approved by AICTE, Delhi, Affiliated to JNTU, Kakinada)

Accredited with "A" Grade by NAAC

Department of Electrical and Electronics Engineering

Academic year: 2017-18 **Year/Semester: III/II** **Regulation: R13**

Name of the subject: UTILIZATION OF ELECTRICAL ENERGY

This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Demand side management concepts are also introduced as a part of this course.

LEARNING OBJECTIVES:

- To understand the operating principles and characteristics of traction.
- To acquaint with the different types of heating and welding techniques.
- To study the basic principles of illumination and its measurement.
- To understand different types of lightning system including design.
- To understand the basic principle of electric traction including speed–time curves of different traction services.
- To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management of energy.

SYLLABUS

UNIT–I:

Selection of Motors

Choice of motor, type of electric drives, starting and running characteristics– Speed control–Temperature rise–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 AC and DC Welding

UNIT–III:

Illumination fundamentals

Introduction, terms used in illumination–Laws of illumination–Polar curves– Integrating sphere–Lux meter–Sources of light

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UNIT–IV:

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 lighting and flood lighting–LED lighting.

UNIT–V:

Electric Traction – I

System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services –Trapezoidal and quadrilateral speed time curves.

UNIT–VI:

Electric Traction – II

Calculations of tractive effort– power –Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking retardation adhesive weight and coefficient of adhesion– Principles of energy efficient motors.

PREREQUISITE COURSES		
S.no	**Name of the course**	**Year/Semester**
1	Electrical Circuit Analysis-I	I/II
2	Electrical Machines-I	II/I
3	Electrical Machines-II	II/II

COURSE OUTCOMES

Co. No	Course Outcome	Taxonomy Level
C323.1	Explain different types of electrical drives used in a industries	Comprehension
C323.2	identify a heating or welding scheme for given application	knowledge
C323.3	maintain/trouble shoot various lamps and fittings in used in various applications	Analysis
C323.4	explain the different schemes for traction schemes in india	Comprehension

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C323.5	design a suitable scheme of speed control for the traction systems	Synthesis
C323.6	identify the job/higher education/research opportunities in electrical utilization industry	Knowledge

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CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C323.1	2											
C325.2	2											
C325.3	2		3									
C325.4	2											
C325.5	2				2							
C325.6	2								3		2	

LESSON PLAN

L/T No	TOPIC NAME	Teaching Aid	Text / REF Book	No of Classes Required	Page Number
	UNIT –I Selection of Motors				
1.1	Introduction	GB&CP	R2	1	187
1.2	Choice of motor, type of electric drives	GB&CP	T2	1	125-129
1.3	starting and running characteristics	GB&CP	T2	2	131-133
1.4	Speed control	GB&CP	T2	2	136-143
1.5	Temperature rise	GB&CP	T1	2	ss63-66
1.6	Applications of electric drives	GB&CP	T1	2	104-117
1.7	Types of industrial loads–continuous–Intermittent and variable loads	GB&CP	R3	2	100-103
1.8	Load equalization	GB&CP	R2	2	231-233
1.9	Problems	GB&CP	R2	2	233-234
	UNIT-II Electric Heating & Electric Welding				
2.1	Introduction to electric heating	GB&CP	T2	1	319
2.2	Advantages and methods of electric heating	GB&CP	T2	1	319-320
2.3	Resistance heating	GB&CP	T2	1	320-322
2.4	Induction heating	GB&CP	R2	2	289-293
2.5	dielectric heating	GB&CP	R2	2	296-299

2.6	Introduction to Electric welding	GB&CP	R2	1	301
2.7	Resistance and arc welding	GB&CP	R2	2	302-308
2.8	Electric welding equipment	GB&CP	R3	1	400
2.9	Comparison between AC and DC Welding and problems	GB&CP	R3,T2	2	R3(431-32),T2-346
	UNIT-III Illumination fundamentals				
3.1	Introduction to illumination	GB&CP	R2	1	313
3.2	Terms used in illumination–Laws of illumination	GB&CP	R2	3	315-318, 321-327
3.3	Polar curves– Integrating sphere	GB&CP	R2	2	318-321
3.4	Lux meter–Sources of light	GB&CP	T2	2	428
3.5	problems	GB&CP	T2	2	471-473
	UNIT-IV Various Illumination Methods				
4.1	Discharge lamps, MV and SV lamps	GB&CP	T1	2	286-291
4.2	Comparison between tungsten filament lamps and fluorescent tubes	GB&CP	R2	2	338-340, 341-342
4.3	Basic principles of light control	GB&CP	T2	1	459-460
4.4	Types and design of lighting and flood lighting	GB&CP	T2	2	464-466, 481-484
4.5	LED lighting and problems	GB&CP	R2	2	327-331, 338, 344
	UNIT-V Electric Traction – I				
5.1	System of electric traction and track electrification	GB&CP	T2	1	530-534
5.2	Review of existing electric traction systems in India	GB&CP	T2	1	522-528
5.3	Special features of traction motor	GB&CP	R2	2	379-380, 382-383, 385-387
5.4	Mechanics of train movement	GB&CP	T2	2	554-560
5.5	Speed–time curves for different services	GB&CP	T2	2	539-542
5.6	Trapezoidal and quadrilateral speed time curves	GB&CP	T2	2	542-544
5.7	problems	GB&CP	R2	2	362-365,366
	UNIT-VI Electric Traction – II				
6.1	Calculations of tractive effort– power	GB&CP	T2	2	545-552
6.2	Specific energy consumption for given run	GB&CP	T2	1	552-553
6.3	Effect of varying acceleration and braking retardation	GB&CP	T2	1	553-554
6.4	Adhesive weight and braking retardation adhesive weight and coefficient of adhesion	GB&CP	T2	3	555-561
6.5	Principles of energy efficient motors	GB&CP	Web	2	Web
6.6	problems	GB&CP	T2	2	561-570

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Name of the subject: UTILIZATION OF ELECTRICAL ENERGY

	TOTAL CLASS (L+T)			**71**	

Learning Resourses:GB&CP: Glass board & Chalk Piece,

TEXT BOOKS:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.

2. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai & Sons.

Reference Books:

1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.

2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.

3.Utilisation of Electric Power & Electric Traction-by G.C.Garg, Khanna Publishers

Web : https://www.slideshare.net/jagadeeshmadhura/e

Signature of Faculty Signature of HOD

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Name of the subject: UTILIZATION OF ELECTRICAL ENERGY

QUESTION BANK

UNIT-I

1. What are the factors governing the selection of motors?
2. Mention advantages of electric drives over other drives.
3. a) What factors govern the selection of a motor for particular drive application.
   b) What do you understand by matching of speed torque characteristics of load and motor?
   c) In what way buck and boost method of speed control is superior to ward leonard method?
4. a) What are the advantages of equipment operated from high frequency supply?
   b) What is the advantage of constant current supply system?
   c) Where would you recommend slip coupling method of speed control?
5. What are different types of industrial loads?
6. a) What are the conditions for stable operation of a motor?
   b) Explain the principle of operation of a saturable reactor?
7. What is load equalization?
8. a) What are relative advantages and disadvantages of d.c.and a.c. drives?
   b) What are the different classifications of load and how they affect the motor selection?
   c) For what type of speed torque characteristic, would you recommend shunt motor?
9. Explain various characteristics to be considered for selection of electric drive.
10. a) Explain in detail the general consideration in selecting motor power ratings.
    b) A motor fitted with a fly wheel that supplies a load of torque 500m for 33 sec. during no load period the fly wheel regains its original speed. The motor torque is required to be limited to 400n-m. The no load speed of the motor is 800 rpm and its full load slip is 10% determine the moment of inertia of the fly wheel.
11. a) "If a high degree of speed control is required, d.c. is preferable to a.c. for an electric drive" -Justify.
    b) What do you mean by Load Equalization?
12. a) Discuss the advantages and disadvantages of electric drive over other drives.
    b) A 200 V shunt motor has an armature resistance of 0.5 Ohm. It takes a current of 16 amps on full load and runs at 600 r.p.m. If a resistance of 0.5 ohm is placed in the armature circuit, find the ratio of the starting torque to the full load torque.
13. a) " Torque in a shunt motor varies with the armature current" –Justify
    b) What are various types of electric braking used?
14. a) Compare and contrast the slip ring and squirrel cage induction motors from the application point of view.
    b) A series motor working on 500 V d.c supply runs at a speed of 1000 r.p.m. When The load current is 120 amp. The resistance of the motor 0.15 ohm, of which 0.04 ohm is the resistance of the field. Calculate the speed of the motor when the torque is half of the full load torque and the field winding is connected in parallel with a diverter of resistance 0.08 ohm, assuming an unsaturated magnetic circuit.
15. What do you mean by "Individual drive" and" Group drive".
16. a) Though a.c. is superior to d.c. for electric drives, sometimes d.c. is preferred. Give the reasons and mention some of the applications.
    b) A d.c. series motor drives a load, the torque of which varies as the square of the speed. The motor takes current of 30 amps, when the speed is 600 r.p.m. Determine the speed and current when the field winding is shunted by a diverter, the resistance of which is 1.5 times that of the field winding. The losses may be neglected.

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17. a) What are various types of electric braking used?
    b) Explain how rheostatic braking is done in D.C. shunt motors and series motors.
18. What are the various factors that govern the choice of a motor for a given service?
19. a) Explain what do you mean by "Individual drive" and "Group drive ". Discuss their relative merits and demerits.
    b) A 500 V d.c. series motor runs at 500 r.p.m. and takes 60 amps. The resistances of the field and the armature are 0.3 and 0.2 Ohms, respectively. Calculate the value of the resistance to be shunted with the series field winding in order that the speed may be increased to 600 r.p.m., if the torque were to remain constant. Saturation may be neglected.

UNIT-II

1. a) What is welding?
   b) Describe the construction and principle of working of an induction furnace.
   c) What type of electric supply is suitable for electric arc welding?
2. What is the purpose of using reactors in electric arc furnace.
3. a) What are different types of welding?
   b) Find the energy consumed and the rating of a tin melting furnace in order to melt 500 Kg of tin in 30 minutes. Take melting point of tin as 235^0C, specific heat as 0.055, latent heat of fusion as 13.31Kcal per kg, initial temperature as 20^0C and furnace efficiency of 75%
   c) What are the advantages of using coated welding electrodes?
4. Why electric heating is preferred over other methods of heating.
5. a) What do you mean by negative resistance characteristics of an electric arc?
   b) A piece of insulating material is to be heated by dielectric heating. The size of the piece is 100 sq.cm area and 2.5cm thick. A frequency of 25 mega cycles is used and the power absorbed is 350W. Calculate the voltage necessary for heating and the current that flows in the material. The material has relative permittivity of 5 and a p.f. of 0.05.
   c) What is the advantage of submerged arc welding?
6. List out the electric welding equipment
7. a) What is the technique of weld metal deposition by electric arc?
   b) What are specific advantages and applications of dielectric heating?
   c) What are the qualities of a good weld?
8. a) What are the characteristics of heating element? Explain the design of heating element in resistance heating.
   b) Explain the core type Ajax Wyatt furnace with a neat diagram.
9. a) What is electric welding? Explain various types of electric welding processes.
   b) Explain about electric welding process and equipment required.
10. a) List out the properties of heating element.
    b) What is the difference between plastic welding &fusion welding?

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UNIT-III

1. Define Illumination?
2. a) Explain how emitted energy is distributed using spectral distribution curves .
   b) Explain the functionality of a Lux Meter?
3. What is Frescher's law of illumination.
4. a) Describe two ways of how glare is produced and suggest how it can be avoided?
   b) What are the main faults of lighting systems and how they are overcome?
5. a) State and explain laws of illumination.
   b) Define i) candle power ii) luminous intensity iii) illumination iv) luminous efficiency.
   c) Two similar lamps having uniform intensity of 500 candle power in all directions below the horizontal are mounted at a height of 4 meters. What must be the maximum spacing between the lamps so that the illumination on the ground midway between the lamps shall be at least one half the illuminations directly under the lamps?
6. A lamp of 200W having an M.S.C.P. of 400 is suspended 2 meters above a working surface. Calculate (i) Lamp efficiency (ii) Total luminous flux in a radius of 0.20m just below the lamp.
7. Define: i) Mean spherical Candlepower, ii) Mean horizontal Candlepower.
8. a) Explain the different measurement techniques used for luminous intensity.
   b) A lamp fitted with 120 degrees angled cone reflector illuminates circular area of 200 metre in diameter. The illumination of the disc increases uniformly from 0.5 metre-candle at the edge to 2 metre-candle at the centre.
   Determine
   i. the total light received
   ii. Average illumination of the disc
   iii. Average c.p. of the source.
9. A lamp of 500 candle power is placed at the centre of a room, 20m×10m×5m. Calculate the illumination in each corner of the floor and a point in the middle of a 10m wall at a height of 2m from floor.
10. Write short notes on :
    a) High pressure mercury vapour lamp
    b) Mercury fluorescent lamp.

UNIT-IV

1. What is illumination level?
2. a) Compare Tungsten filament lamp with Fluorescent tubes.
   b) Explain the different types of lighting schemes.
3. a) What are discharge lamps? Explain.
   b) Write how planned maintenance of lighting installation is done?
4. What is a cold lamp?
5. a) Write a brief note on LED lighting.
   b) Explain the "silhouette" principle on which modern street lighting depends?
6. Define (i) waste light factor (ii) depreciation factor (iii) coefficient of utilization.

7. a) Describe the construction and working principal of (i) sodium vapour lamp (ii) mercury vapour lamp.
   b) A hall measuring 20mx50m is to be illuminated by suitable lamps to give an average illumination of 45 lux. The following data may be used :
   Mounting height from the working plane =3m
   Utilisation factor =0.65
   Depreciation factor =1.3
   The lamps are to be chosen from the following groups:
   Rating in watts 75 100 150 200
   Total lumens 800 1,200 2,000 2,800
   Calculate the number of lamps of each type.

8. a) Discuss the flood lighting with suitable diagrams.
   b) Along the center of a line of a corridor, number of lamps is fitted with reflectors. The distance between the two adjacent lamps is 7.5cm and the height of each lamp from the floor is 5m. The candlepower of each lamp is 100 in all directions below the horizontal. Determine the maximum and minimum illumination along the centerline of the floor and draw a graph showing the variation of the illumination along this line between the two lamps

UNIT-V

1. What are the advantages of diesel electric traction.
2. a) Write the requirements of traction motors.
   b) Review the existing electric traction systems in India.
3. What are the disadvantages of diesel electric traction.
4. a) Explain the function of a reactor used in series with traction motors?
   b) What are special features of a traction motor?
5. What type of motors find application in traction work?
6. a) What is the tractive effort required to overcome train resistance, explain?
   b) Discuss the merits and demerits of the D.C and 1-phase A.C systems for the main and suburban line electrification of the railways.
7. How direction of rotation of a traction motor is reversed?
8. a) What is notching up period? Write brief note on speed time curves of trains.
   b) Define the term tractive effort. Derive the condition for tractive effort required to balance the gravitational pull.
9. a) From the simplified speed- time curve, determine the maximum speed, when the actual time of run, values of acceleration, retardation and the distance between stops are given.
   b) An electric train is to have acceleration and breaking retardation of 0.8 Km/h/s and 3.2 Km/h/s respectively. If the ratio of maximum to average speed is 1.3 and time for stops 26 seconds, find schedule speed for a run of 1.5 km. Assume simplified trapezoidal speed-time curve.
   c) List out the factors effecting scheduled speed.
10. Draw the speed-time curve of a suburban service train and explain

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UNIT-VI

1. Define the term braking retardation.
2. a) A 200 tonne electric train with scheduled speed of 40 kmph runs between two stations 2 km apart with an acceleration of 2 kmphps and braking retardation of 3kmphps. The train resistance is 50 Nw-m / tonne, effect of rotational inertia 10%,over all efficiency 70% and station stop 10 sec.
calculate.
   i) The maximum power output from the wheels
   ii) The specific energy consumption.
   b) Explain the terms
   i) Adhesive weight ii) Train resistance iii) Speed time curve
3. Explain train resistance referred to traction.
4. a) Derive the necessary expressions for tractive effort of fraction system.
   b) Explain various systems of transmission of drives bringing out their merits and demerits.
5. Explain accelerating weight referred to traction.
6. a) Explain dead weight, accelerating weight and train resistance referred to traction
   b) A train is required to run between the two stations 1.5 km apart at a schedule speed of 36 km ph, the duration of stop being 25 sec. The braking retardation is 3 kmphps.
   Assuming a trapezoidal speed/time curve, calculate the acceleration
   if the ratio of maximum speed to average speed is to be 1.25.
7. Explain dead weight referred to traction.
8. a) What are the advantages and disadvantages of thyristor controlled traction motors?
   b) Discuss the suitability of d.c.shunt and series machines for regenerative braking.
9. a) Derives the expression for the tractive effort for train on a level track.
   b) Define(i) dead weight (ii) accelerating weight (iii) adhesive weight.
   c) 400 tonne goods train is to be hauled by a locomotive up a gradient of 2% with an acceleration of 1 km/h/s, coefficient of adhesion is 20%, track resistance 40N/tonnes and effective rotating masses 10% of the dead weight. Find the weight of locomotive and the number of axis, if the axle load is not to increase beyond 22 tones.