Government of Karnataka
Department of Technical Education

C-25 Diploma Electrical & Electronics Engineering Curriculum

Scheme of Studies

(Effect from the AY 2025-26)

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

III Semester Scheme of Studies

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/ week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	EE	25EE31I	Generation, Transmission And Distribution	4	0	4	8	6	50	20	50	20	-	-	100
2	EE	25EE32I	Switchgear and Protection	4	0	4	8	6	50	20	50	20	-	-	100
3	EE	25EE33I	Generators & Transformers	3	0	4	7	5	50	20	-	-	50	20	100
4	EE	25EE34I	Analog and Digital Electronics	3	0	4	7	5	50	20	-	-	50	20	100
Audit Course															
5	KAN	25KA31T	Kannada –I Sahithya Sinchana-I/Balake Kannada-I	2	0	0	2	2	50	20	-	-	-	-	50
Total				**16**	**0**	**16**	**32**	**24**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	Electrical & Electronics Engineering	**Semester**	**III**
Course Name	Generation, Transmission and Distribution	**Type of Course**	Integrated
Course Code	**25EE31I**	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L: T:P 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

The Generation, Transmission, and Distribution (GTD) subject is a cornerstone of electrical engineering, focusing on the journey of electricity from production to consumption. This subject is crucial for diploma students as it builds a comprehensive understanding of power systems, equipping them with the skills to address real-world energy challenges.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Select suitable sites for Hydro, Thermal,Nuclear power plants based on geographical, environmental, and economic considerations.
CO-02	Analyse load curves of different power plants and identify the components of over head and UG cable transmission line .
CO-03	Prepare schedule of materials for Transmission lines, compute transmission line voltage regulation and efficiency of short transmission lines and identify the components of HVDC system
CO-04	Read and Interpret Layout drawings of sub-stations, select size of capacitor banks for substations
CO-05	Prepare schedule of materials for HT and LT lines, compute rating of Distribution transformer center with specifications.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1, 2, 4	● **Introduction**-Importance of electrical power generation. ● Sources of energy available in nature.	video demonstration and prepare a report using Visit/Animations/ Video programme.
		1, 2, 4	**Hydropower plant** - ● Factors to be considered for selection of site ● Classification of Hydroelectric Power Plants (Based on available head of water, plant capacity, load, and construction)	1 Types of hydro power plants, Classification of Hydro power plants https://youtu.be/2Ya1i7oQphg?si=PT3ykzf-PEyuP5fj
		1, 2, 4	● General layout of hydro power plant and explain its components. ● water hammering effect and its prevention.	2. **Hydroelectric Power Plant working and components** https://youtu.be/_c9tBOjny28?si=uhltKzUW92AkB54t
		1, 2, 4	● Advantages and Disadvantages of Hydroelectric power plant ● Environmental Impact of Hydro power plants.	● Locations of these different types of Large and Micro-Hydro Power Plants in Karnataka
2	1	1, 2, 4	**Thermal power plant-** ● Factors to be considered for selection of site. ● General layout of thermal (steam) power plant.	Sketch and interpret the schematic diagram of the thermal power station (T.P.S.) and its main cycles. https://youtu.be/WR1vDFLqdnc?si=OZooFilsk9JW4-O-
		1, 2, 4	● Working of a thermal power plant. ● Discuss Advantages and disadvantages of Thermal power plants.	video demonstration of the working of T.P.S.
		1, 2, 4	● Ash handling and necessity of cooling towers	
		1, 2, 4	● Compare thermal power plant with hydroelectric power plant	
3	1	1, 2, 4	**Nuclear power plant-** ● Factors to be considered for selection of site , ● Schematic diagram of nuclear power plant.	Video demonstration of the working of a nuclear power station (N.P.S.) https://youtu.be/edo1lozuwCs?si=gCpCX3oiugx1-4mo
		1, 2, 4	● Construction and working of Nuclear power plant	
		1, 2, 4	● Nuclear power plant impacts on environment ● Nuclear waste disposal environmental effects.	
		1, 2, 4	**Diesel power plant-** ● Schematic diagram of a Diesel generator unit and explain its components	
4	2	1, 2, 4	**Economics of Power Generation and Interconnected Power System** ● Types of loads ● Types and importance of load curve	● Load curve of Campus/ Institute building(s) and calculation of following economical factors: Maximum demand, Average load, Load Factor, Reserve capacity, Plant capacity factor, utilization factor, Plant use factor and Diversity factor
		1, 2, 4	● Terms and factors regarding load curve, Load duration curve	
		1, 2, 4	● Solve problems on : load curve , load duration curve, Base load and peak load power plants	
		1, 2, 4	● Tariff - Meaning, types and Problems	Prepare and interpret load curve for given data/data collected from nearby power station/substation

5	2	**1, 2, 4**	**Transmission Line Components, Parameters and Performance** ● Explain AC transmission and distribution system with typical single line diagram, ● Mention standard AC transmission (STRUCTURE OF POWER SYSTEM)	● 1a. Identify Different components of Overhead Transmission lines. ● 1b. Identify various conductors viz., All aluminium conductor (AAC, AAAC, ACSR conductor.) ● video demonstration the steps involved in erection of the transmission tower. https://youtu.be/PaaUwwLR0v8?si=87JpSeCq0USgexJf
		1, 2, 4	● Classification of transmission lines based on distance and voltage level.	
		1, 2, 4	● Main components of overhead transmission lines.	
		1, 2, 4	● List the advantages and limitations of high voltage transmission.	
6	2	**1, 2, 4**	**Underground (UG) Power Transmission Systems** ● Transmission Through UG System ● Compare overhead and UG systems.	● Demonstrate various types of conductors used in overhead transmission lines. ● Identify different parts of various underground cables. https://youtu.be/aBI0InMxjGw?si=NzUT-1kcPRNt-KY5
		1, 2, 4	● Classification of UG Cables ● Types of UG Cables Based on Construction	
		1, 2, 4	● General Construction of a Single-Core UG Cable (with Diagram) ● Diagram and construction of 3 core XLPE cables	
		1, 2, 4	● Methods of Laying UG Cables, Their Merits and Demerits	
7	3	**1, 2, 4**	● Prepare the schedule of materials (only) for running of 50 KM 66 KV single circuit transmission line.	● Simulate a given short transmission line-. Find i. Sending end active and reactive power ii. Receiving end active and reactive power. iii. Voltage regulation and Transmission efficiency. compare simulation results with calculated values
		1, 2, 4	● Determine voltage regulation and transmission efficiency of short transmission line.	
		1, 2, 4	● Explain Corona, formation of corona, factors affecting corona, advantages and disadvantages,	
		1, 2, 4	● Methods to reduce corona. ● Meaning of skin effect and Ferranti effect.	
8	3	**1, 2, 4**	**HVDC, FACTS** ● HVDC transmission lines-block diagram, ● list and explain the functions of main components of HVDC transmission system	● Demonstrate HVDC Power transmission ● Demonstrate types of FACTS controllers
		1, 2, 4	● Types of HVDC links –monopolar, bipolar and Homo-polar DC links. ● Advantages Of HVDC transmission, Limitations of HVDC transmission.	
		1, 2, 4	● FACTS Controllers- Definition, Objectives ● Basic types of FACTS controllers and their functions.	
		1, 2, 4	● Compare HVDC and HVAC system	

9	3	**1, 2, 4**	**SUBSTATIONS** ● Meaning of substation and receiving station and their functions ● Classification of substations ● Comparison between outdoor and indoor substation.	● Prepare and submit a report by visiting nearby substation and observing the following ● protection schemes ● Transformers used and their ratings ● earthing ● Bus bar and coupling arrangement ● Incoming lines and outgoing feeders ● Other components with their details
		1, 2, 4	● SLD Of 66/11 KV substation	
		1, 2, 4	● Bus bar arrangement-list the types-explain with diagram single bus arrangement with and without sectionalisation	
		1, 2, 4	SLD of the following bus bar arrangements ● Double Busbar Arrangement	
		1, 2, 4	● Double Busbar with Transfer Bus Arrangement using bus coupler ● Ring Busbar Arrangement	
10	4	**1, 2, 4**	● Need of Capacitor banks, their specifications	Read and Interpret Layout drawings of 220kV/110kV/66kV outdoor substations. Interpret various panel wiring drawings of substation equipment
		1, 2, 4	● Selection and calculation of capacitor bank.	
		1, 2, 4	● Explain the importance of interconnecting substations in large power systems.	
		1, 2, 4	● Functions of Load Dispatch center	
11	4	**1, 2, 4**	**DISTRIBUTION SYSTEM** ● Explain with a diagram AC distribution system. ● Classification of AC distribution systems.	Observe the various componentsof the Distribution System by visiting the MUSS and prepare a report on: 1. Number of feeders connected 2. Energy consumption of each feeder 3. Number of DTC meters connected 4. Percentage of distribution losses 5. 11kV Feeders Interruption Details 6. Operation of 11kV feeders supplying power to IP sets in open delta
		1, 2, 4	● List and explain the connection schemes of distribution system-radial, ring main and interconnected systems.	
		1, 2, 4	● Distinguish between Feeder, distributor and service main.	
		1, 2, 4	● Concept of voltage drop in feeders/distributors with problem on singly fed distributor	
12	5	**1, 2, 4**	● Prepare the schedule of materials(only) for 11 KV single circuit HT line for Rural Electrification	11 kV line installation 1. Observe the operation of distribution transformer 2. Observe the fixing of lightning arrester 3. Check the installation of earth connection as per standard procedure 4. Observe the connection oflow voltage cables 5. Identify Aerial bundled cables for LT and HT 6. Observe the online top changeover
		1, 2, 4	● 11 KV HT Lines (overhead type) only- List the Materials with specifications.	
		1, 2, 4	● 415 V LT lines-List the Materials (only) with specifications and specify the method of calculating various LT line materials.	
		1, 2, 4	● Prepare the schedule of materials (only) for 3 phase 4 wire LT line for Electrification of a factory. One simple example.	
13	5	**1, 2, 4**	**TRANSFORMER CENTRE** ● Transformer center –Describe the types- Pole mounted,plinth mounted, indoor and outdoor types.	Prepare the schedule of equipment and materials with specifications for a 11KV/415V, 100 KVA transformer center.

		1, 2, 4	● Solve one simple example on determining the rating of Distribution Transformer. Write Specifications Of the Distribution Transformer.	● List the materials required with specifications for the installation of the transformer center (e.g., transformer, oil, bushings, protection devices, control panel, etc.).
			● Prepare the schedule equipment/ Materials with specifications for a11KV/415V,100 KVA transformer center.	
			● Prepare the schedule equipment/ Materials with specifications for a11KV/415V,200 KVA transformer center.	

4. References:

1. Generation of Electrical Energy, by B.R.Gupta, publisher S.chand & company LTD, New Delhi
2. Electrical Power Generation, Transmission and Distribution. - S.N.Singh. PHI Publications.
3. Generation Distribution and Utilisation of electric energy by C.L. Wadwa, -New-Age International Publisher
4. Substation design and equipments-P.S Satna-Dhanpatrai.
5. Transmission, distribution and utilization – vol 3 B.L Theraja and A.K.Theraja.
6. Transmission and Distribution of Electric Power by J.B Gupta Katsons Publications.

5. CIE Assessment Methodologies

Sl. No	**CIE Assessment**	**Test Week**	**Duration (minutes)**	**Max marks**	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

6. SEE - Theory Assessment Methodologies

Sl. No	**SEE – Theory Assessment**	**Duration**	**Exam Paper Max marks**	**Exam Paper Max Marks scale down to (Conversion)**	**Min marks to pass**
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper

Program	ELECTRICAL AND ELECTRONICS ENGINEERING			**Semester -III**	
Course Name	GENERATION,TRANSMISSION AND DISTRIBUTION			**Test**	**I/III**
Course Code	**25EE31I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Explain why electrical power generation is important for daily life. b) What are the factors to be considered for selecting a site for a hydropower plant? c) Classify hydropower plants based on their capacity. d) Explain the general layout of a hydropower plant and its components	L2 L1 L2 L2	1	5+5+5+ 10-=25
2	a) Explain the factors to be considered for selecting a site for a thermal power plant? b) List the Advantages and disadvantages of Thermal power plants c) Explain Necessity of Nuclear waste disposal. d) Explain the general layout of a thermal power plant and its components.	L2 L1 L2 L2	1	5+5+5+ 10-=25
3	a) What are the factors to be considered for selecting a site for a nuclear power plant? b) Discuss the environmental impacts of nuclear power plants and ways to mitigate it c) Compare and contrast diesel generator units with other types of power plants. d) Explain the construction and working of a nuclear power plant.	L2 L2 L3 L2	1	5+5+5+ 10-=25
4	a) What is the meaning of tariff in electricity sector? b) Explain the importance of load classification in electrical power system. c) Explain the difference between a daily load curve and an hourly load curve. d) Discuss the impact of different types of loads on electrical power system design.	L2 L2 L3 L2	1	5+5+5+ 10-=25
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	ELECTRICAL AND ELECTRONICS ENGINEERING			**Semester**	**III**
Course Name	GENERATION,TRANSMISSION AND DISTRIBUTION			**Test**	**II/IV**
Course Code	**25EE31I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
● Identify Different components of Overhead Transmission lines. ● Identify various conductors viz., All aluminium conductor (AAC, AAAC, ACSR conductor.) ● Identify different parts of various underground cables. ● Simulate a given short transmission line-. Find i. Sending end active and reactive power ii. Receiving end active and reactive power. iii. Voltage regulation and Transmission efficiency. compare simulation results with calculated values	1 2 2	**50**

Scheme of assessment	
a) Portfolio evaluation of practice sessions (week 1 to week 7)	**05**
b)Identify Different components /OH/UG/(AAC, AAAC, ACSR/ Transmission lines	**10**
c) Simulate a given short transmission	**20**
d) Results	**10**
e)Viva-voce	**05**
TotalMarks	**50**

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose **any two** activities that are relevant to the topic

Sl.No.	Suggestive Activities
01	**Objective**: To understand the various types of power plants, their working principles, components, environmental impacts, and factors influencing site selection. Students will compare and analyze the differences between hydroelectric, thermal, nuclear, and diesel power plants. **Activity**: ● **Research and Comparison**: ○ Students will research and write a comparative report on the four types of power plants: ■ **Hydroelectric Power Plants**: Discuss the importance of site selection (head of water, capacity, load, etc.), the general layout of the plant, and the effects of water hammering and its prevention. ■ **Thermal Power Plants**: Discuss the factors for site selection (availability of fuel, water, etc.), the general layout, and the working principle of a thermal plant. ■ **Nuclear Power Plants**: Study the factors for site selection, schematic diagram, working principle, and environmental impacts of nuclear power plants. ■ **Diesel Power Plants**: Provide a schematic diagram of a diesel generator unit and explain the components.
02	**Objective**: To understand the structure of power transmission systems, their components, and the differences between overhead transmission lines and underground cables. Students will also analyze the equations and parameters involved in short transmission lines. Activity: ● Transmission Line Diagram and Components: ○ Students will draw a typical AC transmission system diagram, including components like transmission towers, conductors, insulators, and transformers. They will label and describe each component. ○ Discuss the standard transmission and distribution voltages used in various systems and their importance in voltage regulation. ● Overhead vs. Underground Transmission: ○ Compare overhead transmission lines and underground cables by listing the advantages and limitations of each system. ○ Students will identify the types of underground cables based on construction (e.g., single-core, multi-core) and explain the general construction of a single-core underground cable using a diagram. ○ Discuss the merits and demerits of overhead and underground systems in terms of cost, maintenance, reliability, and environmental impact.
03	**Objective**: To prepare a detailed schedule of materials for setting up 66 KV and 110 KV single circuit transmission lines. **Activity**: ● Provide students with a task to prepare a schedule of materials required for constructing 80 KM of a 66 KV and a 110 KV single circuit transmission line. ● Include the necessary components such as conductors, insulators, tower structures, earthing materials, support hardware, and safety equipment. ● Instruct students to categorize materials by type (e.g., steel for towers, copper/aluminum for conductors, porcelain for insulators).
04	**Objective**: To explore the structure and functioning of distribution systems and the connection schemes used in various power distribution scenarios. **Activity**: ● **AC Distribution System**: Begin by explaining the classification of **distribution systems** (e.g., primary, secondary), and then discuss the **AC distribution system** with a diagram. ● Have students sketch an **AC distribution system**, labeling components such as substations, transformers, feeders, distributors, and service mains. Discuss how voltage is stepped down in various stages and how electricity is distributed to the consumers.

05	**Objective**: To list materials and calculate the necessary components for 415V Low Tension (LT) lines. **Activity**: ● Explain the components of a 415V LT line, including **conductors, poles, insulators, and other necessary accessories** (e.g., LT distribution boxes, fuses). ● Guide students to prepare the **schedule of materials** for a typical LT line, specifying: ○ **Conductors**: Type, size (e.g., aluminum, copper), number of wires ○ **Poles**: Type (e.g., wood, cement, steel), height, material ○ **Insulators**: Type (e.g., pin type, shackle type), voltage rating ○ **LT Fuses**: Ratings, application ● Explain and solve a sample problem calculating the **material requirements** for an LT line, considering factors such as distance, load, and voltage drop.

10. Rubrics for Assessment of Activity(QualitativeAssessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	StudentsScore
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks=(8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Computer Systems	smart class room	1
02	Projector and Display System	Miniature working model showing turbine, dam, and water flow	1
03	Hydro Plant Model	Miniature working model with boiler, turbine, and generator	1
04	Thermal Power Plant Model	Components: Reactor, steam generator, turbine	1
05	Nuclear Power Plant Model	Includes towers, conductors, and insulators	1
06	Electrical Transmission Line Model	Includes towers, conductors, and insulators	1
07	Cables and Accessories	HT Cables (11 kV and above) LT Cables (up to 1.1 kV) Termination kits and joining kits Cable cutters, strippers, and testers	
08	Tools for Wiring and Termination	Insulated screwdrivers Crimping tools Multimeters (Digital and Analog) Cable insulation testers (Megger)	

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Program	Electrical & Electronics Engineering	**Semester**	**III**
Course Name	Switchgear and Protection	**Type of Course**	Integrated
Course Code	**25EE32I**	**Contact Hours**	8 hours/ week 104 hours/semester
Teaching Scheme	L: T:P 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

Switching and protective devices are vital for the control of various components such as generators, transmission lines, transformers, etc of a power system. Switchgear protects the system from the damage and ensures continuity of supply. Switchgear is an integral part of an electrical system in industries, hospitals, apartments, commercial and domestic buildings. An electrical and electronics diploma graduate should be capable to test, commission, troubleshoot and maintain electrical switchgear.

2. Course Outcomes : At the end of the Course, the student will be able to:

CO-01	Test and operate a given switchgear component.
CO-02	Choose the appropriate switchgear for a particular application and use them optimally.
CO-03	Test and provide protection schemes for power system components, such as generators, transformers, feeders.
CO-04	Work on AMF, APFC, STP panels and test substation grounding.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,4	**Introduction to Protective Systems** ● Need for protective systems in electrical power networks ● Nature and causes of electrical faults **Faults in Power Systems** ● Definition of symmetrical and unsymmetrical faults in three-phase systems ● Types of unsymmetrical faults ● Causes of short circuits and their harmful effects	Identification of different types of fuses and their applications. Measure and select the appropriate size of fuse wire.
			Switchgear and Protection Systems ● Definition and importance of **switchgear** ● Differences between **Indoor and Outdoor switchgear** ● Components of a protection system	
			Essential Switchgear Devices Listing and explanation of: ● Switches ● Fuses ● Circuit breakers ● Relays **Fuse as a Protective Device** ● Composition and function of fuses ● Advantages and disadvantages of using fuses **Important fuse-related terms:** ● Current rating of fuse element ● Fusing current ● Fusing factor ● Prospective current ● Cut-off current	Test the HRC fuse by performing a Load test
			High Rupturing Capacity (HRC) Fuses ● Types and applications of HRC fuses ● General construction and working principle of HRC fuses ● Merits and demerits of HRC fuses	
2	1	1,2,4	**Circuit Breaker** – Introduction to Circuit Breakers ● **Meaning and importance** of circuit breakers in power systems ● **Operating principle** of circuit breakers ● **Key terminologies** related to circuit breakers: ○ Arc Voltage ○ Restriking Voltage ○ Recovery Time ○ Arcing Time ○ Pre-Arcing Time ○ Total Operating Time	Test the MCB and plot its inverse time characteristic curve.

			Advanced Concepts in Circuit Breakers Further terminologies explained: ● Prospective Current ● Transient Recovery Voltage (TRV) ● Recovery Voltage ● Rate of Rise of Recovery Voltage (RRRV) ● Total Break Time **Performance ratings of Circuit Breakers:** ● Making Current ● Breaking Current ● Short Circuit Rating ● Short-Time Current Rating	Test any commercially available **ACCL, ELCB.**
			MCBs, Miniature Circuit Breakers (MCB): ● Types ● Applications ● Working principle ● Comparison of Fuse vs. MCB ● Advantages and limitations	
			Advanced Protection Devices Working Principle and Applications of: ● Earth Leakage Circuit Breaker (ELCB) Residual Current Circuit Breaker (RCCB) **Concept of Automatic Changeover with Current Limiter (ACCL):** ● Purpose and Functioning ● Applications in power distribution	
3	**1, 2**	**1, 2, 4**	● Working principle and applications of MCCB, MPCB.	Test MCCB, MPCB.
			HV Circuit Breaker- ● OCB construction and working of Plain oil circuit breaker, ● advantages and disadvantages of OCB	
			● explain, axial-blast and cross-blast types.ACB. ● advantages, disadvantages of ACB.	Visit to Substation. Identify the parts of circuit breaker and check its operation. Video demonstration on Installation, operation and maintenance of OCB, ACB and SF6 circuit breaker.
			● SF6 Circuit Breaker- construction, working, advantages and disadvantages.	
4	**1,2**	**1,4**	● Problems on circuit breaker ratings.	Demonstration of various parts of an electromechanical relay. Demonstration of time setting multiplier, pick up current setting for the relay operation.
			Protective Relay- ● Fundamental requirements of Protective Relaying. ● Classification of protective relays- based on technology, based on speed of operation, based on function.	

			• Importance of CTs and PTs for protection. • Important Terms: pick up VA, Hold-on VA, drop out VA and Burden Pickup current, current setting, PSM, TSM, Time-PSM Curve. • Problems.	Test Electromechanical overcurrent relay and plot the time vs current inverse characteristics of the relay.
			• Construction, working principle and applications of Non-directional Induction type Electromechanical over current relays. • Advantages and disadvantages of Electro-mechanical relays.	
5	**1,2**	**1, 4**	• Construction. Working principle and application of Earth Leakage relay. • Meaning of ZCT (Zero-Phase Current Transformers), CBCT (Core balance CT)-and application.	1a) Rig up a circuit to test the earth leakage relay. 1b) Testing of Microprocessor based over current relay.
			• Block diagram and working of Microprocessor/Microcontroller based over current relays.	
			• Construction, working and applications of Static OV/UV and OCR relay- block diagram approach.	2a) Rig up the circuit to test static OV/UV relay 2b) Rig up the circuit to test Phase failure/phase reversal relay.
			• Construction and operation of Numerical relay- block diagram approach.	
6	**1,2**	**1, 4**	• Advantages of Numerical relays, • Comparison between Electromechanical, static and Numerical relays.	Program and test Numerical relay
			Causes of over voltages- • Internal causes- switching surges, Insulation failure, Arcing ground, resonance and • External Causes-lightning, explain lightning phenomenon.	
			Lightning arresters, • Types of lightning arresters, • Working principle of Rod gap and Horn gap arresters. • Advantages and limitations.	Video demonstration on functioning of lightning and surge arresters.
			Surge absorbers- • Definition and working of Ferranti type surge absorbers.	
7	**3**	**1,4**	**Protection of transformers-** • Common transformer faults, • Protection system for transformers,	1a) Test the operation of Buchholz Relay. 1b) Demonstrate the differential protection of a transformer using Matlab Simulink.
			• Construction and operation of Buchholz relays, • Advantages, and disadvantages of Buchholz relay • Transformer oil properties,	

			● Construction and working of Earth fault or leakage protection systems for transformer, ● Construction and working of Circulating current scheme of transformer protection (Differential protection of transformer)	1a) Conduct BDVT on Transformer oil. 1b) A 3-phase transformer of 220/11,000 line volts is connected in star/delta. The protective transformers on 220 V side have a current ratio of 600/5. What should be the CT ratio on 11,000 V side?
8	**3**	**1, 4**	Protection of Alternators- ● list different types of faults in alternators. Differential protection of Alternators (Merz-Price circulating current scheme)- ● Schematic arrangement, operation and limitations. ● Stator-inter turn protection of alternators. ● Construction and working of Balanced earth fault protection of alternators.	Video demonstration on protection of alternator from faults. Simulate and study the waveform pattern for Alternator protection scheme.
9	**1, 3**	**1, 2, 4**	Feeder Protection- ● list different types of faults on feeders/ transmission line. ● Time graded over current protection of a radial feeder using definite time relays and inverse time relays. Parallel feeder, ● Protection of parallel feeders. ● Advantages of parallel feeders, ● Differential pilot wire protection- Merz-Price voltage balance system.	Simulate and study the waveform pattern for Feeder protection scheme. Simulate/Test the operation of Differential Relay
10	**1,2, 3**	**1,2,4**	Distance protection- ● Principle and operation. Testing of Circuit breakers- ● Necessity of testing Circuit breakers, ● different testing methods of CBs. ● Maintenance of circuit breakers.	Simulation of Distance protection relay. Video demonstration on testing of circuit breakers
11	**2,3**	**4**	Testing of CTs- ● list type and routine tests- ● Error measurement test-direct method,, ● turns ratio tests, exciting current tests. ● Polarity test, Insulation test, Testing of PTs- ● List the Type tests- ● polarity test, Insulation test, ● list routine tests.	1a) Video demonstration on testing of CTs 1b) Burden test on CT to determine its VA rating. Video demonstration on testing of PTs
12	**4**	**4**	Substation Grounding- ● Equipment grounding, ● system grounding, ● functions of earth mat. Neutral grounding, ● Methods of neutral grounding- solid grounding, ● Merits of of neutral grounding,	Demonstrate Substation earthing.

			• advantages and disadvantages of solid grounding. • Resistance grounding, advantages, disadvantages,	
			• reactance grounding, disadvantages, • Peterson coil.	Testing of Motor protection against thermal over load.
13	**4**	**4**	• EMR 5000 motor protection relay- key features, functions, benefits and applications.	Test the operation of APFC
			APFC- • Automatic power factor control panel, working and applications.	
			AMF- • Automatic mains failure detection panel, working.	Test the operation of AMF
			STP- • Standard temperature and pressure control panel, working and application.	

4.References:

(i) Principles of Power Systems by V.K.Mehta, Rohit Mehta

(ii) Power system protection and switchgear by Badri Ram, and D Vishwakarma

(iii) Sunil S.Rao, *"Switchgear Protection and Power Systems",* 1999 11th edition, Khanna Publishers

(iv) J.B.Gupta "Switchgear & Protection", (edition), Katson Publisher,2008

(v) MadhavaRao T.S., 'Power System Protection - Static Relays', McGraw Hill, New Delhi,2nd Edition, 21st reprinted, 2008.

(vi) Testing , commissioning , operation and maintenance of electrical equipment by Sunil S Rao ,Khanna Publications

(vii) Power System Protection and Switchgear by Buvanesh A Oza, Nirmalkumar C Nair, Rases P Mehta and Vijay H Makwana, McGraw HILL Education (India Pvt. Ltd) New Delhi

(viii) https://www.youtube.com/watch?v=KwEdrgAoW0c

(ix) https://www.youtube.com/watch?v=vpcRY0SLt1o

(x) https://www.youtube.com/watch?v=Q9iEg0TRreE

(xi) https://www.youtube.com/watch?v=kEGTHhp1iV8

(xii)https://www.youtube.com/watch?v=T9_8xxp_TR8

(xiii) https://www.youtube.com/watch?v=iP4H9Tuu1Xo

5. CIE Assessment Methodologies

Sl. No	**CIE Assessment**	**Test Week**	**Duration (minutes)**	**Max marks**	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

CIE Theory Test model question paper

Program	**Electrical & Electronics Engineering**			**Semester -III**	
Course Name	**Switchgear and Protection**			**Test**	**I/III**
Course Code	**25EE32I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Define the term switchgear and list the essential features of switchgear.	L1	CO1	5
	b) Explain the causes and effects of short-circuits.	L2		5
	c) Explain operating principle of a circuit breaker.	L2		5
	d) Explain the working of MCB.	L2		5
	e) Compare fuse with MCB.	L2		5
2	a) Define the term fuse and list the advantages of fuse.	L1	CO1	5
	b) Explain the working of a HRC fuse.	L2		5
	c) Discuss the terms (i) Arc Voltage and (ii) Restriking Voltage.	L2		5
	d) Explain the operation of ACCL with the help of a circuit diagram.	L2		5
	e) Compare fuse with circuit breaker.	L2		5
	Section - 2			
3	a) Explain the construction and working principle of Sulphur Hexafluoride (SF_6) circuit breaker.	L2	CO2	10
	b) Explain the term Protective Relay with the help of a typical relay circuit.	L2		9
	c) List any three advantages and the disadvantages of oil circuit breakers.	L2		6
4	a) A circuit breaker is rated as 1500 A, 1000 MVA, 33 kV, 3-second, 3-phase oil circuit breaker. Find (i) rated normal current (ii) breaking capacity (iii) rated symmetrical breaking current (iv) rated making current (v) short-time rating (vi) rated service voltage.	L2	CO2	10
	b) Explain the principle of Earth leakage relay.	L2		9
	c) List any three advantages and disadvantages of Air circuit breakers.	L1		6

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

8. CIE Practice Test model question paper

Program	Electrical & Electronics Engineering			Semester	III
Course Name	Switchgear and Protection			Test	II/IV
Course Code	25EE32I	Duration	180 min	Marks	50

Name of the Course Coordinator:

Questions	CL	Marks
1. Portfolio evaluation of practice sessions (week 1 to week 7)	L4	05
2. Demonstrate the operation of switchgear with suitable circuit and plot its characteristics (testing of a relay/fuse/MCB /MCCB/MPLCB)	L4	40
3. Viva-voce	L4	05
Scheme of assessment		
a) Portfolio evaluation of practice sessions (week 1 to week 7)		05
b)Writing the circuit diagram, procedure, standard graphs, etc.,		15
c) Demonstration of testing of relay/fuse/MCB /MCCB/MPLCB) for a given operation.		20
d) Results		05
e)Viva-voce		05
Total Marks		50

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose **any two** activities that are relevant to the topic

Sl.No.	Suggestive Activities for Tutorials
01	Prepare a hardware model consisting of PB switches (START & STOP) and contactor to run the three phase induction motor. Using earth leakage relay, trip the motor against earth faults and submit a report on this.
02	Prepare a hardware model consisting of PB switches (START & STOP) and contactor to run the three phase induction motor. Using Static OV/UV relay, trip the motor against voltage variations and submit the report on this.
03	Build Automatic mains failure model using contactors and relays and submit a report on this.
04	Build an Automatic power factor control model and submit the report on this.
05	Visit a manufacturing industry, study the protection circuits of the industry and submit a report on this.
06	Visit a substation, study protection mechanisms used in the substation and submit a report on this.

10. Rubrics for Assessment of Activity(QualitativeAssessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	StudentsScore
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks=(8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30students

Sl.No.	Particulars	Specification	Quantity
01	Different types of fuses such as kit-kat fuse, cartridge fuse, glass fuse etc	----	2 Nos each
02	HRC Fuse with fuse base	10A	4 Nos
	MCB	Single pole, 2A	4Nos
03	Digital Time Interval Meter 0-999 ms, 0-99.9 sec, 0-99.9 min		4 Nos
04	ACCL- Automatic change over with current limiter	Single phase/ Three phase 6A/20A	4 Nos
05	ELCB /RCCB	2 pole, 32 A/ 220 V, 3 to 30 mA	4 Nos
06	MCCB- Moulded case circuit breaker	100A, 3Pole	4 Nos
07	MPCB-Motor protection circuit breaker	6-10 A, 3 pole	4 Nos
08	Transformer- Current injection	240/24 V, 20A 240/12 V, 50 A	4 Nos 1 No
09	Transformer- Voltage injection	240/600 V	4 Nos
10	Electromechanical relay - OCR/EFR / trainer kit	Current setting 0.5-10 A	1 Set
11	Earth leakage relay with CBCT	10 A or 16 A 415 V 30 mA or 100 mA ELR with 5 A/1A CBCT	2 Set
12	Static relay- OV/UV/Phase failure, reversal	415 V, OV setting of 105% to 120 % and UV setting of 95 % to 80%	2 Nos
13	Numerical relay/ trainer kit	Standard inverse curve 3s/10 or 1.3s/10 OR Very inverse/ Extremely inverse	1 set
14	BDVT test kit for testing the insulation strength of transformer oil.	220 V, 50 Hz 0-100 kV	1 set
15	Alternator protection module/panel	Protection against field failure, stator faults, frequency variations, prime mover failure etc.	1 set
16	Feeder protection module/panel	Time graded over current protection – definite/inverse time relays.	1 set
17	Current transformer	100/5 A, 50/5A	2 Nos.
18	Thermal over load relay	3 phase, 415 V, 0-4.5 A, or 0-6A, or 0-10 A	2 Nos.
19	Automatic mains failure kit/ panel	Single phase/ Three phase 6A/16 A 230 V /415 V	2 set
20	Automatic power factor control kit/ panel	440 V, 20 KVAr	2 set

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electrical & Electronics Engineering**	**Semester**	**Third**
Course Name	**Generators & Transformers**	**Type of Course**	Integrated
Course Code	**25EE33I**	**Contact Hours**	7 hours/week 91 hours/semester
Teaching Scheme	**L:T:P- 3:0:4**	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale

This course provides a comprehensive understanding of electrical machines, focusing on DC generators, AC generators (alternators), and transformers, which are essential for power generation, transmission, and distribution. It covers construction, working principles, performance analysis, efficiency, and testing of these machines. The study of voltage regulation, parallel operation, and special transformers ensures practical knowledge for real-world applications. Emphasis is given to loss minimization, energy efficiency, and maintenance of electrical machines. The content aligns with industry needs, ensuring students gain both theoretical and practical expertise in electrical machines.

2. Course Outcomes : At the end of the Course, the student will be able to:

CO-01	Analyze the performance of DC Generators
CO-02	Analyze the performance of AC Generators
CO-03	Analyze the performance of Transformers
CO-04	Conduct maintenance on Generators and Transformers

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,2,3,	**Fundamentals of DC Generators** Ref(1) ● Principle of Working of a DC Generator – Energy conversion from mechanical to electrical. ● Construction & Functions of Various Parts – Armature, Field Windings, Commutator, Brushes, etc.	Identification of various parts of DC Generator.
	1		**EMF Equation & Angle Relationships** ● Derivation of EMF Equation of a DC Generator. ● Relationship between Electrical Angle & Mechanical Angle – Importance in machine operation.	Identification of Armature winding, Series field winding, Shunt field winding by Megger / Test lamp / Multimeter
	1		● Solving Numerical Problems related to EMF equation.	
2	1		**Classification of** DC Generators ● Types of DC Generators – Shunt, Series, and Compound generators. ● Circuit Diagrams for different types of DC Generators.	Wire Up DC Separately excited, Shunt, Series Generators
	1		● Voltage & Current Equations of Shunt, Series, and Compound generators. Derivation and explanation.	
	1		**Problem Solving & Practical Applications** ● Solving Numerical Problems based on Voltage & Current equations.	Wire Up DC Cumulative,Differential Long shunt & Short Shunt Compound Generators.
3	1		● Analysis of Performance Characteristics – Effect of load on different types of DC generators. ● Real-life Applications of DC Generators in industries, power backup, and traction systems.	Plot the Open circuit characteristics of DC Shunt Generator Plot the Load characteristics - Internal and External DC Shunt Generator
	1		● Power Flow stages in DC Generators. ● Various losses,	DC Shunt Generator – Losses and efficiency by Direct Loading
	1		● Efficiency equation and Problems.	
4	2		**AC Generators** Ref(1) ● Principle of working of 3-Phase AC Generator. ● Concept of Synchronous Generator. ● Construction of AC Generator and functions of various parts.	Identification of various parts of Alternator.
	2		● Classification of Synchronous Generators, applications. ● Relationship between frequency, poles and Synchronous speed.	Identification of Armature winding, field winding by Megger / Test lamp / Multimeter
	2		**AC windings** Types- ● Concentrated, Distributed, Full pitch, Factional Pitch ● Definitions and equations of Pitch factor, Distribution factor, Winding factor	
5	2		● Derivation of EMF equation of Synchronous Generator and related problems.	**Calculation of** Pitch factor, Distribution factor, Winding factor
	2		● Armature resistance, Synchronous Reactance and Synchronous Impedance.	

	2		● Open Circuit, Short circuit & Load characteristics of Synchronous Generators. ● Procedure, circuit diagram and equations. Equivalent circuit of Alternator	Conduct OC test and SC test on Alternator and Calculate ● Armature resistance, ● Synchronous Reactance ● Synchronous Impedance
6	**2**		Alternator on **NO-Load** and **ON-Load**. Vector diagrams On Load under ● Unity power factor ● Lagging power factor ● Leading power factor	**Load test on Alternator** Estimate the Voltage regulation by direct loading at Unity, Lagging and Leading power factors.
	2		**Armature reaction-** Effect on terminal Voltage. Phasor diagram approach.	Find the efficiency of alternators for different loads and power factors by conducting OC and SC tests on it.
	2		● Voltage Regulation and different methods of finding it. ● Equations for Voltage Regulation under Unity, lagging and Leading power factors.	
7	**2**		Related Problems. on Voltage Regulation	
	2		**Parallel Operation of Alternators** ● Necessity ● Conditions ● Circuit diagram – ● Two Alternators in Parallel, ● Alternator parallel to Infinite Bus bar	Connect two Alternators in parallel and share the load between them
	2		Effect on Load Sharing between Alternators under ● Unequal Voltage ● Variation in Excitation ● Variation in Prime Mover Input **Static Excitation System**	Connect one Alternators in parallel to grid share the load between them
8	**3**		**Transformers** Ref(1) ● Principle of operation ● Construction,	Identify different parts of Transformer, measure the primary & secondary winding resistance
	3		**Functions** of Main parts of a Transformer Classification of Transformers and applications ● Based on construction ● Based on function ● Based on number of Phases	Connect Single Phase Transformers as ● 1:1 Transformer ● Step-DownTransformer ● Step-Up Transformer and measure Primary & Secondary voltages and current.
	3		**Transformer cooling –** ● Various methods, ● Properties of transformer Oil	
9	**3**		**Emf equation of Transformer** ● Derivation, ● Turns Ratio, Transformation Ratio ● Related Problems	Conduct Polarity Test on Transformer
	3		**Transformer on NO-Load,** ● Phasor diagram, ● NO-Load losses, ● Related problems	Obtain the NO-Load equivalent Circuit Parameters of Single Phase Transformer
	3		**Transformer ON Load** ● Resistance and Leakage Reactance, ON Load Losses ● Referred values, Equivalent Resistance and Reactance	

10	**3**		**Equivalent circuit** of Transformer referred to Primary side, Secondary side **Phasor diagram** of Transformer ON Load for ● Unity power factor ● Lagging power factor ● Leading power factor	Obtain the ON-Load equivalent Circuit Parameters of Single Phase Transformer
	3		**Tests on Transformers** ● Open circuit test, Short circuit test, Polarity Test ● Calculation of Equivalent circuit parameters from **OC** and **SC** tests	Find the efficiency of 1-phase Transformer by direct loading
	3		**Voltage Regulation in Transformers,** ● Expressions for Voltage Regulation under Unity, Lagging and Leading power factors. ● Related Problems	
11	**3**		**Efficiency in Transformers** ● Finding Efficiency from OC & SC tests ● Condition for Maximum efficiency - Derivation ● Related Problems	Find the efficiency of 1-phase Transformer by conducting OC & SC test under different loads and power factors.
	3		**All Day efficiency**, related problems	Find the voltage regulation of 1-phase Transformer by conducting OC & SC test under different loads and power factors.
	3		**Three Phase Transformers** – ● Working and construction Various Three Phase connections and its applications ● Star – Star ● Star – Delta ● Delta – Star ● Delta- Delta ● Open Delta (V-V) ● Scott (T – T) **Vector Groups** in Three Phase Transformers ● Importance of Vector Groups ● Common Vector Group Classifications and connections	
12	**3**		**Parallel Operation** of Transformers ● Necessity ● Conditions ● Advantages Two transformers in Parallel – Circuit connections	Connect and measure the primary and Secondary voltages of various combinations of ● Star – Star, ● Star – Delta ● Delta – Star 3-Phase Transformers
	3		**Auto transformer** ● Working ● Copper saving ● Comparison of Auto transformer with two winding transformer **Three winding Transformer** ● Construction & Working Principle ● Applications & Advantages	

	3		**Instrument Transformers** ● Types of Instrument Transformers ● Construction & Working ● Applications & Advantages **Energy Efficient Transformers** ● Types of Energy Efficient Transformers ● Applications & Advantages	Connect and measure the primary and Secondary voltages of various combinations of ● Delta- Delta ● Open Delta (V-V) ● Scott (T – T) 3-Phase Transformers
13	**3**		**Maintenance of Alternators** ● Types of Maintenance ● Key Maintenance Activities	Connect two transformers in parallel and share the load.
	3		**Maintenance of Power transformers** ● Types of Maintenance – Preventive, Predictive, and Corrective maintenance strategies.	Connect an Autotransformer to a load and apply variable voltage.
	3		**Maintenance of Distribution transformers** ● Types of Maintenance ● Key Maintenance Activities	

4. References:

1) Electrical Machines - S.K.Sahdev, Cambridge University Press
2) Direct Current Machines – Rajput RK
3) Alternating Current Machines – Rajput RK
4) Electric Machines – Nagrath & Kothari

5. CIE Assessment Methodologies

Sl. No	**CIE Assessment**	**Test Week**	**Duration (minutes)**	**Max marks**	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

6. SEE - Theory Assessment Methodologies

Sl. No	**SEE – Theory Assessment**	**Duration (minutes)**	**Max marks**	**Min marks to pass**
1.	Semester End Examination-Theory	90	50	20

7. CIE Theory Test model question paper

Program	Electrical & Electronics Engineering			Semester -3	
Course Name	Generators & Transformers			Test	I/III
Course Code	25EE33I	Duration	90 min	Marks	50

Name of the Course Coordinator:

Note: Answer any one full question from each section. Each full question carries equal marks.

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	**a)** Explain the functions of Yoke and Commutator in a DC Generator. **b)** Explain DC long shunt Cumulative and DC short shunt cumulative compound generators with circuit diagram, voltage and current equations. **c)** An eight pole lap wound DC generator has 960 conductors, a flux of 40 mWb per pole and is driven at 400 rpm. Find Open Circuit emf.	L2 L2 L3	CO1	**5** **12** **8**
2	**a)** Explain the internal and external characteristics of DC Cumulative Compound generator. **b)** Explain the power flow stages in a DC generator. **c)** A shunt generator supplies 195 A at 220 V. Armature resistance is 0.02 ohm, shunt field resistance is 44 ohm. If the iron and friction losses amount to 1600 watt, find (i) emf generated; (ii) copper losses; (iii) Efficiency	L2 L2 L3	CO1	**8** **7** **10**
	Section - 2			
3	**a)** Explain Concentrated, Distributed, Full pitch and Fractional Pitch windings. **b)** Derive the relationship between Synchronous speed, poles and frequency in a 3 phase Alternator. **c)** Determine the useful flux per pole required to develop 6600 V across the terminals of a 3-phase, star connected, 50 Hz, 4-pole alternator having 60 slots with 2 conductors per slot. The coils are short pitched such that if one coil side lies in slot No.1 and the other lies in slot No.13. Assume a double-layer winding	L2 L2 L3	CO2	**10** **7** **8**
4	**a)** Draw the Phasor diagrams of Alternator on Load at Leading and Lagging power factors. **b)** Explain the conditions and connections of connecting two 3 phase Alternators in parallel. **c)** A three-phase, star-connected, 1000 kVA, 3300 V, 50 Hz alternator produces a short-circuit current of 200 A and an open circuit voltage of 1040 V with the same field current 40 A. It its armature has an effective resistance of 0.2 ohm per phase, calculate full-load regulation of the alternator at upf, pf of 0.8 lagging and 0.8 leading.	L2 L2 L3	CO2	**6** **10** **9**

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electrical & Electronics Engineering**			**Semester**	**3**
Course Name	**Generators & Transformers**			**Test**	**II/IV**
Course Code	**25EE33I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
NOTE : ANY one among following question may be allotted for each students		**50**
1. Wire Up DC Separately excited, Shunt, Series Generators	**CO1**	
2. Wire Up DC Cumulative,Differential Long shunt & Short Shunt Compound Generators.	**CO1**	
3. Plot the Open circuit characteristics of DC Shunt Generator	**CO1**	
4. Plot the Load characteristics - Internal and External DC Shunt Generator	**CO1**	
5. DC Shunt Generator – Losses and efficiency by Direct Loading	**CO1**	
6. Conduct OC test and SC test on Alternator and Calculate ● Armature resistance, ● Synchronous Reactance ● Synchronous Impedance	**CO2**	
7. Find the efficiency of alternators for different loads and power factors by conducting OC and SC tests on it		
8. Connect two Alternators in parallel and share the load between them		
9. Connect one Alternators in parallel to grid share the load between them	**CO2** **CO2**	
Scheme of assessment		
a) Portfolio evaluation of experiments from Week-01 to Week-06 / Week-07 to Week-13		**5**
b) Circuit diagram and procedure with required components rating, specification and quantity.		**15**
c) Conduction of the experiment with suitable safety precautions and reading tabulation.		**15**
d) Calculations / Graph plotting and final results		**05**
f) Viva		**10**
	TotalMarks	**50**

Signature of the Course Coordinator **Signature of the HOD**

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose **any two** activities that are relevant to the topic

Sl.No.	Suggestive Activities for Tutorials
01	Study harmonics generated in Generators and Transformers 1. List harmonics generated in generators and Transformers 2. Explain long term effects caused by harmonics 3. Limits and levels imposed on odd harmonics by IEC and IEEE 4. Explain how Improved winding configurations can reduce harmonics in generators
02	Study the latest technological changes in this course and present the impact of these changes on industry. Study the data centre generators and 1.List requirements for Data centre generators 2. Specifications of typical Data Centre generator 3. Method employed to reduce harmonic content 4. Protection and cooling method 5.Applicable IEC standards
03	Dismantle and assembly small capacity DC generator and make a note
04	Explain construction and working of On-load tap changing (OLTC) transformer
05	Establish synchronizing arrangements using synchronizing lamps or synchroscope

10. Rubrics for Assessment of Activity(QualitativeAssessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	StudentsScore
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks=(8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. **SEE- Model Practice Question Paper**

Program	Electrical & Electronics Engineering		Semester			
Course Name	Generators & Transformers	Course Code 25EE33I	Duration	180 min		
Questions			CO	Marks		
NOTE : ANY one among following question may be allotted for each students					50	
1. Wire Up DC Separately excited, Shunt, Series Generators				CO1		
2. Wire Up DC Cumulative,Differential Long shunt & Short Shunt Compound Generators.				CO1		
3. Plot the Open circuit characteristics of DC Shunt Generator						
4. Plot the Load characteristics - Internal and External DC Shunt Generator				CO1		
5. DC Shunt Generator – Losses and efficiency by Direct Loading				CO1		
6. Conduct OC test and SC test on Alternator and Calculate				CO1		
● Armature resistance,				CO2		
● Synchronous Reactance						
● Synchronous Impedance						
7. Find the efficiency of alternators for different loads and power factors by conducting OC and SC tests on it				CO2 CO2		
8. Connect two Alternators in parallel and share the load between them						
9. Connect one Alternators in parallel to grid share the load between them				CO2		
10.						
Scheme of assessment						
a) Portfolio evaluation of experiments from Week-01 to Week-13				5		
b) Circuit diagram and procedure with required components rating, specification and quantity.				15		
c) Conduction of the experiment with suitable safety precautions and reading tabulation.				15		
d) Calculations / Graph plotting and final results				05		
f) Viva				10		
Total Marks				50		

1) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/softwarelistwithSpecificationforabatchof30students

Sl No.	Particulars	Specification	Quantity
1	Single-phase transformer	2kVA 1:1	3
2	Single-phase transformer	2kVA 1:0.5	2
3	1-ph Variacs	(0-300lV, 5 A	6
4	3-ph Variacs	(0-440lV,15A	2
5	Potential Transformers	220V-75V	2
6	Current Transformers	5A-1A	2
7	Motor *(DC* Shunt,110/220V, 1500 rpm 3HP and Alternator 3 phase/ ,440V1 , 3KVA/Any KVA Set	as given	1Set
8	Loading Rheostats	Lamp Load	2
9	Wire wound Rheostats	Assorted-range	30
10	Analog Tachometers	standard	3
11	Digital Tachometers	standard , contact or non contact type	3
12	Synchroscope	standard	2
13	Phase sequence indicator	standard	2

14	Portable DC Moving coil ammeter	multirange (0 to 1/ 2/5A 5/10A)	5
15	Portable DC Moving coil Voltmeters	multirange (0 to 1/3/6 volts , 5/10 volts , 150/300 Volts)	
16	Watt meters (Dynamometer type)	i) LPF 75/300/600V,1/2A ii) UPF 75/300/600V, 5/10A iii) UPF 75/300/600V,15/30A	2
17	Frequency meters read type and digital type	standard	2
18	Power factor meters	1 phase 300V, 0 to 1	
19	Megger	500 V, lOOOV, 1500 V	2
20	Earth tester	standard	2
21	Tong tester analog and Digital	standard	2 each
22	Multimeters analog and digital	standard	4 each
23	Electrical & Electronics Circuit Simulation software PSpice/ GNU Octave/MatLab/ Free outsource software	For a batch of 20 students	

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	Electrical and Electronics Engineering	Semester	III
Course Name	Analog and Digital Electronics	Type of Course	Integrated
Course Code	25EE34I	Contact Hours	7 hours/week 91 hours/semester
Teaching Scheme	3:0:4	Credits	5
CIE Marks	50	SEE Marks	50 (Practice)

1. **Rationale**:
Analog Electronic circuits are used to amplify, process and filter analog signals using amplifiers, oscillators, switching circuits, operational amplifiers etc. Digital electronic circuits are usually made from large assemblies of logic gates. This digital logic circuitry is based on a binary system which has only two voltage levels, Low and High viz., Digital computers. Any intelligent electronic system is built by a combination of analog and digital circuits. Hence, it is imperative for any aspiring technician to become acquainted with the concepts of analog and digital electronics.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify the components of a given electronic circuit, list the uses and characteristics of the components and test the components to ensure they are in working condition.
CO-02	Use datasheets to list the alternative electronic components for a given electronic circuit ensuring the results/output remains the same.
CO-03	Build an electronic circuit for a given application and demonstrate its working either in real or a simulated environment.
CO-04	Test a given circuit for desired result/outcome, identify the problem and troubleshoot to obtain the desired result/output.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,4	**ANALOG ELECTRONICS** ● Passive components (Resistor, Inductors and capacitors): Introduction, symbols, units, types/classification, identification, selection and applications.	● Identify different active and passive components. Mention their specifications.
			Semiconductors: ● Definition, types of semiconductor materials (Si, Ge, GaAs). ● List characteristics of semiconductors by energy band diagram.	
			Intrinsic Semiconductors ● Doping a Semiconductor ● Extrinsic Semiconductors (N-type and P- type). ● Concept of majority carrier and minority carriers. ● Formation of PN junction and depletion region.	1.Preparation of components, use of soldering iron and lead and flux. 2.Standard Soldering practice to connect the components on base-board/PCB/assembly board (follow soldering standard).
2	2,3	1,4	**Diode-** ● VI Characteristics, types, ratings and applications. **Zener diode-** ● Reverse bias characteristics, voltage Regulation, shunt voltage regulator and their applications	● Study and interpret data sheets of diodes and ● Zener diodes Execute testing of given diode using multimeter and determine forward and reverse resistance. ● Construct and test Zener based voltage regulator circuit.
			Bipolar Junction Transistors (BJT): ● Structure, Types, symbols, ● Construction, operation of (NPN/PNP) transistors. ● BJT Configurations, ● Transistor currents, alpha, beta and relationship between alpha and beta.	
			CE input and output characteristics- ● cut off, saturation, and active regions **Transistor biasing-** ● Definition, importance, list type ● Explain Voltage divider bias. ● Transistor as a switch in CE mode. ● Stabilisation, thermal runaway, heat sink	● Identify different transistors with respect to different package type, B-E-C pins, power, switching transistor, heat sinks etc ● Obtain output characteristics of BJT in CE configuration in physical mode.
3	1,3	1,4	**MOSFET-** ● Definition, types, symbols, ● N type enhancement mode-construction, working, ● MOSFET characteristics	● Identify terminals of a MOSFET and test its condition of working. ● Rig-up circuit to Obtain output characteristics of MOSFET.
			● MOSFET as switch, ● ratings.	
			● List applications of MOSFET, ● Differentiate between BJT and MOSFET	● Construct and test MOSFET application circuit (MOSFET as a switch)

4	3,4	1,4	**Rectifiers-** ● half wave, centre tapped FWR, efficiency, ripple factor, PIV **Filters-** ● definition, necessity, C and PI filters. Regulated power supply- ● block diagram and applications. ● Regulator- working of 7805, mention operating voltages of 7809, 7812, 7905, 7912 ● Op-amp regulator, 723 regulators (Transistorized & IC based) ● Testing and Troubleshooting of Regulated Power Supply	● Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series) ● Build +5V 1A DC Power Supply ● Build +12V 1A DC Power Supply ● Identify different heat sinks for IC based regulators ● Identify the parts, trace the connection and test the DC regulated power supply with safety ● Troubleshoot and service a DC regulated power supply
5	1,3	1,4	**LED** ● Working of LED, IR LEDs, Photodiode, photo transistor and their and applications. **Opto-couplers,** ● circuits with Opto-Isolators. LASER diodes-characteristics and applications **Amplifier-** ● faithful amplification, classification based on configuration, power, and frequency. Transistor ● Transistor RC coupled amplifier(CE Mode), Frequency response curve, bandwidth Working of Push pull amplifiers.	● IIdentify the different types of LEDs and IR LEDs. ● Identify optocoupler input/output terminals and measure the quantum of isolation between the terminals ● Construct a circuit to switch lamp load using phototransistor ● Construct and test a common emitter amplifier with bypass capacitors.
6	1,3	1,4	**OPAMP–** ● Block diagram, characteristics, μA 741 pin diagram. **OPAMP applications–** ● Inverting, non inverting amplifier, voltage follower. **Timer–** ● Block diagram, IC 555 pin diagram, duty cycle, time-delay, Applications, A stable multi-vibrator using IC 555.	1. Construct and test OP AMP as a Summer. Use an Analog IC tester to test the Analog ICs. 2. Construct and test Astable timer circuit using IC 555. Construct and test mono stable timer circuit using IC 555. Use an Analog IC tester to test the Analog ICs
7	3	1,2	**DIGITAL ELECTRONICS** ● Definitions- bit, nibble, byte, word, and parity bit. ● Number system- definition, types, radix, decimal, BCD, binary and hexadecimal. Binary number system,	● Solve problems on number syste

			● Binary arithmetic: addition, subtraction, multiplication and division Complements: 1's, 2's. Hexadecimal- ● Addition, subtraction, **Conversion-** ● Decimal to binary, decimal to hexadecimal	● Solve problems on conversion.
8	3	1,2,4	● Boolean variable, complement, Boolean function, expression, truth table. Boolean Algebra- rules and laws. **Logic gates** ● NOT, AND, OR- definition, symbol, Boolean equation, truth table and working. Logic gates NAND, NOR, EX-OR- EX-NOR definition, symbol, Boolean equation, truth table and working. De Morgan's theorems-statement and equations	● Realise basic gates using NAND gate. ● a) A home security system has three sensors: one on the door (D), one on the window (W), and one on the motion detector (M). The alarm (A) should go off if: Either the door or the window sensor is triggered, OR The motion detector is triggered while the door is closed. Write the Boolean expression for this alarm system, simplify it if possible, and draw the logic circuit.
			● Karnaugh's map up to three variables- Simplification and drawing logic diagrams.	● Realise basic gates using NOR gate. ● A fan is controlled by temperature sensors (T) and humidity sensors (H). The fan turns on if: The temperature is high (T), OR Both the temperature and humidity are at moderate levels. Formulate the Boolean expression to represent the fan control system. Simplify it if possible and draw the circuit using logic gates.
9	1,3	1,4	**COMBINATIONAL LOGIC CIRCUITS-** ● Half adder- block diagram, logic diagram, truth table and working. ● Full adder- block diagram, logic diagram using truth table and working.	● Construct Half Adder circuit using ICs and verify the truth table ● Construct Full adder with two Half adder circuits using ICs and verify the truth table.
			Multiplexer and Demultiplexer, ● 4:1 MUX, ● 1: 4 DEMUX ● List applications of MUX and DEMUX	● Construct a circuit to verify the truth table of 4:1 multiplexer using IC 74153 and 1:4 Demultiplexer using IC 74139.
10	1,3	1,4	**Encoders and Decoders-** ● Definition, applications. Seven segment display- working. **FLIP-FLOPS:** ● S-R flip-flops, Clocked RS flip flop- block diagram, truth table, logicdiagram.	● Construct a circuit to display 0-9 digits using standard Seven segment display with the help of decoder/ driver IC 7446/ or 7447.

			● JK flip-flop- block diagram, truth table, logic diagram.	● Identify different Flip-Flop ICs ● Verify the truth tables of Flip-Flop ICs (RS, JK) by connecting switches and LEDs.
11	1,3	1,4	**Shift Registers-** ● Definition, types and applications. ● Four-bit SISO using D Flip flops - block diagram, truth table and operation.	● Construct and test a four-bit SIPO register.
			● Four-bit SIPO, PISO and PIPO shift registers using D flip flops- block diagram, truth table and operation.	
			Counters- ● Definition, modulus concept, timing diagram, types and applications	● Construct and test four-bit PIPO register.
12	3,4	1,4	**Four-bit binary asynchronous counter-** ● Block diagram using JK flip flops, truth table, timing diagram and working	● Construct and test 4-bit Asynchronous binary up /down counter
			Four-bit decade asynchronous counter- ● Block diagram using JK flip flops, truth table, timing diagram and working.	
			Three-bit synchronous up counter- ● Block diagram, truth table, timing diagram and working.	● Rig up and test the truth table of Decade Asynchronous Counter
13	1,3	1,4	**Digital to Analog converters:** ● Binary weighted Resistor, DAC- block diagram and operation.	● Construct and test (Binary weighted Resistor) Digital to Analog converter circuit.
			D/A converter specifications: ● Resolution, accuracy and conversion speed. ● Selection criteria for DAC	
			Analog to Digital converters: ● Successive Approximation ADC- block diagram and operation. ● Selection criteria for ADC	● Construct and test the Analog to Digital converter circuit.

4. References:

1. Electronic Devices and Circuits theory by Robert L. Boylestad Louis Nashelsky
2. Electronics Principles by Malvino, Mc. Graw Hill, Third edition. 2000.
3. Electronics Devices and Circuits by Allen Mottershead, PHI Learning Pvt. Ltd., First Edition
4. Electronics Principles and applications by Charles A Schuler and Roger L Tokhiem, Sixth Edition, Mc. Graw Hill, 2008. 2. 3.. 4.. 5.
5. Electronics Analog and Digital by I. J. Nagrath, PHI Learning Pvt. Ltd., 2013 Edition
6. Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Learning Pvt. Ltd., Fourth Edition.
7. Work sheets digital 1. https://www.liveworksheets.com/un1107740kg 2. https://nohoacsl.weebly.com/uploads/1/1/2/2/112297219/ digital electronics worksheet.pdf

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
Total					• Marks

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7.CIE Theory Test model question paper

Program	Electrical and Electronics Engineering			Semester -III	
Course Name	Analog and Digital Electronics			Test	I/III
Course Code	25EE34I	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Define Intrinsic and extrinsic semiconductor. Give example for each. b) Explain the working of PNP transistor with diagram. c) Explain how transistor is used as a switch in CE mode. d) Explain the operation of full wave bridge rectifier with the help of circuit and waveforms.	1 2 3 4	1 2,3 1,3 3,4	5 8 6 6
2	a) Define resistor and capacitor. Mention their symbol and units. b) Draw and explain the VI characteristics of a PN Junction Diode. c) Explain the concept of thermal runaway. How it is prevented? d) Explain the operation of half wave rectifier with the help of circuit and waveforms.	1 2 3 4	1 2,3 1,3 3,4	5 8 6 6
	Section - 2			
3	a) List any 5 applications of transistor. b) Explain how Zener diode can be used as voltage regulator with the help of a circuit. c) Explain the characteristics of semiconductors using energy band diagram. d) Illustrate input and output characteristics of transistor in CE mode.	1 2 3 4	1,3 2,3 1 1,3	5 8 6 6
4	a) Define transistor biasing. List the different types of transistor biasing. b)Explain the reverse bias characteristics of a Zener diode with the help of a circuit and graph. c) Compare Intrinsic and Extrinsic semiconductors. d) Explain Voltage divider bias.	1 2 3 4	1,3 2,3 1 1,3	5 8 6 6
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.				

Signature of the Course Coordinator Signature of the HOD Signature of the IQAC Chairman

8. CIE Practice Test model question paper

Program	Electrical and Electronics Engineering			Semester	III
Course Name	Analog and Digital Electronics			Test	II
Course Code	25EE34I	Duration	180 min	Marks	50
Name of the Course Coordinator:					

Questions	CO	Marks
NOTE : ANY one among following question may be allotted for each students 1. Zener diodes Execute testing of given diode using multimeter and determine forward and reverse resistance 2. Construct and test Zener based voltage regulator circuit. 3. Obtain output characteristics of BJT in CE configuration in physical mode. 4. Rig-up circuit to Obtain output characteristics of MOSFET 5. Construct and test MOSFET application circuit (MOSFET as a switch) 6. Build +5V 1A DC Power Supply 7. Build +12V 1A DC Power Supply 8. Construct a circuit to switch lamp load using phototransistor 9. Construct and test OP AMP as a Summer 10. Construct and test Astable timer circuit using IC 555. 11. Construct and test mono stable timer circuit using IC 555	1,3 1,3	50
Scheme of assessment a)Portfolio evaluation of Practice Sessions b) Draw the Circuit diagram using the standard symbols with procedure and expected outcome. c) Build the circuit as per the circuit diagram d)Demonstrate the working of the circuit. e) Document the necessary readings of the circuit outcomes. f) Viva-Voce		5 10 10 10 5 10
	TotalMarks	50

Signature of the Course Coordinator Signature of the HOD

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose **any two** activities that are relevant to the topic

Sl.No.	Suggestive Activities for Tutorials (Minimum two activities)
01	Build a (0 –30) V variable output regulated power supply using IC LM317 circuit. test the circuit for desired output and demonstrate the working of circuits in the class.
02	Build an Automatic Fence Lighting Circuit with Alarm.
03	Build Adjustable Dual Timer Circuit using 555 Timer IC.
04	Build logic gates using lamp and switches
05	A fan is controlled by temperature sensors (T) and humidity sensors (H). The fan turns on if: The temperature is high (T), OR Both the temperature and humidity are at moderate levels. Formulate the Boolean expression to represent the fan control system. Simplify it if possible and draw the circuit using logic gates.
06	Build a simple digital alarm system that triggers a buzzer when motion is detected.
07	Build a simple traffic light system with three LEDs and timed states (Red, Yellow, Green) using 555 Timer ICs.
08	Production line control Rods of varying length travel on conveyor belt ● Mechanical arm pushes rod within (+/- 5%) to one side ● Second arm pushes rods too long to other side ● rods that are too short stay on belt ● 3 light barriers (light source photocell) as sensors Design combinational circuit to activate arms. (Inputs are three sensors and outputs are two arm control signals)

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Excellent	Good	Satisfactory	Needs Improvement (4 or below)	Students Score
		9-10	7-8	5-6	<=4	
1	Understanding of Concepts	Demonstrates thorough understanding of underlying concepts and explains them confidently.	Shows good understanding of concepts with minor gaps.	Demonstrates basic understanding but struggles with deeper applications.	Lacks understanding of concepts or is unable to explain them clearly.	8
2	Implementation Skills	Writes efficient, well-structured, and commented code with appropriate logic.	Writes functional and mostly clean code with minor inefficiencies.	Writes basic code with some inefficiencies and lack of comments or structure.	Writes poor or non-functional code with little to no structure or comments.	6
3	Teamwork/Collaboration	Actively collaborates, contributes ideas, and supports peers effectively.	Participates well, shares ideas, and collaborates with minor lapses.	Participates minimally and may not engage fully with peers.	Does not participate in teamwork or creates disruptions within the team.	7
4	Presentation of Results	Explains the results and process clearly with accurate conclusions.	Presents results with minor inaccuracies or gaps in explanation.	Struggles to explain results clearly or makes incorrect conclusions.	Fails to present results clearly or shows lack of understanding of the process.	9
5	Adherence to Time	Completes the task well within the allotted time with no compromise on quality.	Completes the task on time with minor compromises in quality.	Completes the task with significant delay or compromises in quality.	Fails to complete the task within the allotted time or quality is highly compromised.	10
					TOTAL MARKS	40

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. SEE- Model Practice Question Paper

Program	Electrical and Electronics Engineering		Semester	III
Course Name	Analog and Digital Electronics	Course Code **25EE34I**	Duration	180 min
Both the sections are compulsory. Each full question carries equal marks.			25EE34I	Marks

PART A

1. Construct and test Zener based voltage regulator circuit.	1	20
2. Obtain output characteristics of BJT in CE configuration in physical mode.		
3. Rig-up circuit to Obtain output characteristics of MOSFET		
4. Construct and test MOSFET application circuit (MOSFET as a switch)		
5. Build +5V 1A DC Power Supply	3	20
6. Build +12V 1A DC Power Supply		
7. Construct a circuit to switch lamp load using phototransistor		
8. Construct and test OP AMP as a Summer		
9. Construct and test Astable timer circuit using IC 555.		
10. Construct and test mono stable timer circuit using IC 555		

PART B

1. Realise basic gates using NAND gate.		
2. A home security system has three sensors: one on the door (D), one on the window (W), and one on the motion detector (M). The alarm (A) should go off if:		
3. Realise basic gates using NOR gate.		
4. A fan is controlled by temperature sensors (T) and humidity sensors (H). The fan turns on if: The temperature is high (T), OR Both the temperature and humidity are at moderate levels.		
5. Construct Half Adder circuit using ICs and verify the truth table		
6. Construct Full adder with two Half adder circuits using ICs and verify the truth table.		
7. Construct a circuit to verify the truth table of 4:1 multiplexer using IC 74153 and 1:4 Demultiplexer using IC 74139.		
8. Construct a circuit to display 0-9 digits using standard Seven segment display with the help of decoder/ driver IC 7446/ or 7447.		
9. Verify the truth tables of Flip-Flop ICs (RS, JK) by connecting switches and LEDs		
10. Construct and test a four-bit SIPO register.		
11. Construct and test four-bit PIPO register.		
12. Construct and test 4-bit Asynchronous binary up /down counter		
13. Rig up and test the truth table of Decade Asynchronous Counter		
14. Construct and test (Binary weighted Resistor) Digital to Analog converter circuit.		
15. Construct and test the Analog to Digital converter circuit.		

Scheme of assessment	
a) Draw the Circuit diagram using the standard symbols with procedure and expected outcome. 5 marks(Part A)+5 marks(Part B)	10
b) Build the circuit as per the circuit diagram. 5 marks(Part A)+5 marks(Part B)	10
c) Demonstrate the working of the circuit. 5 marks(Part A)+5 marks(Part B)	10
d) Document the necessary readings of the circuit outcomes. 5 marks(Part A)+5 marks(Part B)	10
e) Viva-Voce	10
Total Marks	50

1) Signature of the Examiner

2) Signature of the Examiner

12. Equipment/softwarelistwithSpecificationforabatchof30students

Sl.No.	Particulars	Specification	Quantity
01	DC Regulated power supply	(0-30V, 2A)	10
02	DC Regulated Dual power supply	(+/- 15V,2A)	10
03	DC Regulated Dual power supply	(+/- 5, 1A	10
04	Cathode Ray Oscilloscope	Dual trace, 25 MHz	10
05	Signal Generator / Function generator	(5V P-P, 200mA)	06
06	DC Voltmeter	(0-1V)	10
07	DC Voltmeter	(0-10V)	10
08	DC Voltmeter	(0-30V)	10
09	DC Ammeter	(0 -100mA)	05
10	DC Ammeter	(0 -10mA)	10
11	Digital Multimeter	31 /2” 06	06
12	Analog Multimeter		06
13	LCR meter		02
14	Decade resistance box	(4 Dial)	10
15	Decade capacitor box	(4 Dial)	10
16	Analog IC Trainer Kit		10
17	Digital Trainer kit		10
18	Digital IC Tester		02
19	Electronic Circuit Simulation Software (Multisim/Pspice/ LT spice/GNU-Octave/ MatLabSimulink)		20