Final

DIPLOMA CURRICULUM OF ELECTRICAL ENGINEERING (SECOND YEAR) (4th Semester)

(To be implemented from 2025-26)

Prepared by;

National Institute of Technical Teachers' Training & Research Kolkata
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Vetted by:
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PROGRAMME TITLE: ELECTRICAL ENGINEERING

SEMESTER - IV

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme				Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory		Practical			
					L	T	P	End Exam	Progressive Assessment	End Exam	Progressive Assessment		
1	Programme Core	EEPC202 TH:1	Fundamentals of Power Electronics		3	0	0	70	30	-	-	100	3
2		EEPC204 TH:2	Electric Power Transmission and Distribution	EEPC 201	3	0	0	70	30	-	-	100	3
3		EEPC206 TH:3	AC Machines and Special Electrical Machines	EEPC 207	3	0	0	70	30	-	-	100	3
4		EEPC208 PR:1	Power Electronics Laboratory		0	0	4			15	35	50	2
5		EEPC210 PR:2	AC machines and special electrical machines laboratory	EEPC 217	0	0	4			15	35	50	2
6	Programme Elective	EEPE202 (Any one) TH:4	(a) Electrical Testing and Commissioning (b) Linear Control Systems (c) Communication Technologies		3	0	0	70	30	-	-	100	3
7		EEPE204 (Any one) TH:5	(a) Sensors & Actuators' (b) Electrical Estimation and Contracting (c) Industrial Instrumentation and Condition Monitoring		3	0	0	70	30	-	-	100	3
8		EEPE206 (Any one) PR:3	(a) Electrical Estimation and Contracting Laboratory (b) Linear Control System Laboratory (c) Sensors & Actuators Laboratory (d) Electrical Testing and Commissioning Laboratory (e) Power System Simulation Laboratory		0	0	4	-	-	15	35	50	2
9	Minor Project	PR202 PR:4	MINOR PROJECT		0	0	4	-	-	30	70	100	2
10	Mandatory*	AU202	Essence of Indian knowledge and tradition		2	0	0	-	-	0	0	0	0
TOTAL					**17**	**0**	**16**	**350**	**150**	**75**	**175**	**750**	**23**

*All Audit (mandatory) courses will have assessment, but will have no credit.

SEMESTER - IV COURSES

TH:1- FUNDAMENTALS OF POWER ELECTRONICS

L	T	P		Course Code: EEPC202	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PC	

RATIONALE:

Power Electronics is an interdisciplinary area using the thyristor family devices to control the ON and OFF processes of semiconductor switches and principles of control theory. The application area of power electronics can have two-sided development – one as the development of improved performance power semiconductor devices and the other side as development of control circuit of these devices. This course includs power electronic devices, thyristor family devices, turn-on and turn-off methods of thyristors, phase controlled rectifiers and industrial control circuits including SMPS and UPS.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Explain the operating principle of power electronic devices
- Select power electronic devices for specific applications
- Describe the turn-on and turn-off methods of thyristors
- Explain the operation and applications of phase-controlled rectifiers.
- Discuss the operating principle of industrial control circuits.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Power Electronic Devices** 1.1 Power electronic devices 1.2 Power transistor 1.2.1 construction and working principle 1.2.2 V-I characteristics and uses 1.3 IGBT 1.3.1 Construction and working principle 1.3.2 V-I characteristics and uses 1.4 Concept of single electron transistor (SET) 1.5 Aspects of Nano- technology(concept only)	10

II	**Thyristor Family Devices** 2.1 SCR 2.1.1 Construction of SCR 2.1.2 Two transistor analogy of SCR 2.1.3 Types, working and characteristics 2.1.4 SCR mounting and cooling 2.2 Types of Thyristors: SCR, LASCR, SCS, GTO, UJT, PUT, DIAC and TRIAC 2.3 Thyristor family devices 2.3.1 Symbol and construction 2.3.2 Operating principle 2.3.3 V-I characteristics 2.4 Protection circuits 2.4.1 Over-voltage 2.4.2 Over-current 2.4.3 Snubber 2.4.4 Crowbar	10
III	**Turn-on and Turn-off Methods of Thyristors** 3.1 SCR Turn-On methods 3.1.1 High Voltage thermal triggering, 3.1.2 Illumination triggering 3.1.3 dv/dt triggering 3.1.4 Gate triggering 3.2 Gate trigger circuits 3.2.1 Resistance and Resistance-Capacitance circuits 3.3 SCR triggering using UJT 3.4 PUT: Relaxation Oscillator and Synchronized UJT circuit 3.5 Pulse transformer and opto-coupler based triggering. 3.6 SCR Turn-Off methods: 3.6.1 Class A- Series resonant commutation circuit 3.6.2 Class B-Shunt Resonant commutation circuit 3.6.3 Class C-Complimentary Symmetry commutation circuit 3.6.4 Class D-Auxiliary commutation 3.6.5 Class E-External pulse commutation 3.6.6 Class F-Line or natural commutation	8
IV	**Phase Controlled Rectifiers** 4.1 Phase control: firing angle, conduction angle. 4.2 Single phase half controlled, full controlled and midpoint controlled rectifier with R, RL load 4.2.1 Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode 4.3 Different configurations of bridge controlled rectifiers: Full bridge, half bridge with common anode, common cathode, SCRs in one arm and diodes in another arm	10

V	**Industrial Control Circuits** 5.1 Applications: Burglar's alarm system, Battery charger using SCR, Emergency light system, Temperature controller using SCR and; Illumination control/fan speed control TRIAC 5.2 SMPS 5.3 UPS: Offline and Online 5.4 SCR based AC and DC circuit breakers.	7

REFERENCES:

1.	An Introduction to Thyristors and their applications by M. Ramamoorty, East-West Press Pvt. Ltd., New Delhi.
2.	Thyristors: Theory and Applications by Rajendra Kumar Sugandhi and Krishna Kumar Sugandhi, New Age International (P) ltd. Publishers, New Delhi.
3.	Fundamentals of Power Electronics by S.K. Bhattacharya, Vikas Publishing House Pvt. Ltd. Noida.
4.	Power Electronics and its Applications by Alok Jain, Penram International Publishing (India) Pvt. Ltd, Mumbai.
5.	Power Electronics Circuits Devices and Applications by Muhammad Rashid, Pearson Education India, Noida.
6.	Power Electronics by M. D Singh and K.B. Khanchandani, Tata McGraw Hill Publishing Co. Ltd, New Delhi.
7.	Industrial Electronics: A Text –Lab Manual by Paul B. Zbar, McGraw Hill Publishing Co. Ltd., New Delhi.
8.	SCR Manual by D.R. Grafham, General Electric Co.

TH:2- ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

L	T	P		Course Code: EEPC204	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PC	

RATIONALE:

The electric power transmission and distribution subject covers basics of transmission and distribution, transmission line parameters and performance, extra high voltage transmission, a.c distribution system and different components of transmission and distribution line. The aim of this course is to help the student to maintain the proper functioning of the electrical transmission and distribution systems. The aim of this course is to help the student to maintain the proper functioning of the electrical transmission and distribution systems

LEARNING OBJECTIVES:

After completion of the course, the students will be able to

- Explain the basics of electrical power transmission and distribution
- Describe the transmission line parameters and performance of transmission line
- Explain the operation and applications of EHVAC and HVDC
- Discuss the a.c distribution system
- Explain different components of transmission and distribution line

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted time (Hours)
I	**Basics of Transmission and Distribution** 1.1 Single line diagrams with components of the electric supply transmission and distribution systems 1.2 Classification of transmission lines 1.3 Primary and secondary transmission 1.4 Standard voltage level used in India 1.5 Classification of transmission lines: based on type of voltage, voltage level, length and others 1.6 Characteristics of high voltage for power transmission 1.7 Method of construction of electric supply transmission system- 110 kV, 220 kV, 400 kV 1.8 Method of construction of electric supply distribution systems- 220 V, 400V, 11 kV, 33 kV	10

II	**Transmission Line Parameters and Performance** 2.1 Line Parameters: Concepts of R, L and C of line parameters and types of lines 2.2 Performance of short line: Efficiency, regulation and its derivation, effect of power factor, vector diagram for different power factor 2.3 Performance of medium line: representation, nominal 'T', nominal 'π' and end condenser methods 2.4 Transposition of conductors and its necessity 2.5 Skin effect and proximity effect	**9**
III	**Extra High Voltage Transmission** 3.1 Extra High Voltage AC (EHVAC) transmission line**:** Necessity, high voltage substation components such as transformers and other switchgears 3.1.1 Advantages, limitations and applications of EHVAC 3.1.2 EHVAC lines in India 3.2 Ferranti and Corona effect 3.3 High Voltage DC (HVDC) Transmission Line**:** Necessity components, advantages, limitations and applications 3.3.1 Layout of monopolar, bi-Polar and homo-polar transmission lines of HVDC 3.3.2 HVDC Lines in India 3.4 Features of EHVAC and HVDC transmission line 3.5 Flexible AC Transmission line: Features, types of FACTS controller 3.6 New trends in wireless transmission of electrical power	**9**
IV	**A.C Distribution System** 4.1 AC distribution: Components classification, requirements of an ideal distribution system, primary and secondary distribution system 4.2 Feeder and distributor, factors to be considered in design of feeder and distributor 4.3 Types of different distribution schemes: radial, ring, and grid, layout, advantages, disadvantages and applications 4.4 Voltage drop, sending end and receiving end voltage 4.5 Distribution Sub-Station: Classification, site selection, advantages, disadvantages and applications 4.6 Single Line diagram (layout) of 33/11KV Sub-Station, 11KV/400V sub-station 4.7 Symbols and functions of their components	9

V	**Components of Transmission and Distribution Line** 5.1 Overhead Conductors**:** Properties of material, types of conductor with trade names, significance of sag 5.2 Line supports: Requirements, types of line structures and their specifications, methods of erection 5.3 Line Insulators 5.3.1 Properties of insulating material 5.3.2 Selection of material 5.3.3 Types of insulators and their applications 5.3.4 Causes of insulator failure 5.3.5 Derivation of equation of string efficiency for string of three suspension insulator 5.3.6 Methods of improving string efficiency 5.4 Underground Cables**:** Requirements, classification, construction, comparison with overhead lines, cable laying and cable jointing.	**8**

REFERENCES:

1.	Utilization of Electric Power & Electric Traction by G.C. Garg, Khanna Book Publishing Co., New Delhi.
2.	Principles of Power System by V.K. Mehta, S. Chand and Co. New Delhi.
3.	A Course in Electrical Power by Soni; Gupta; Bhatnagar, Dhanpat Rai and Sons New Delhi.
4.	A Course in Power Systems by J.B. Gupta, S.K. Kataria and sons, New Delhi.
5.	A Textbook of Electrical Technology Vol. III, by B.L Theraja,.; A.K. Theraja, S.Chand and Co. New Delhi.
6.	A Course in Electrical Power by, S.L. Uppal,.Khanna Publisher New Delhi.
7.	Electrical Power Transmission and Distribution by S. Sivanagaraju; S. Satyanarayana, Pearson Education, New Delhi.
8.	Electrical Power System: A First Course by Ned Mohan, Wiley India Pvt. Ltd. New Delhi.
9.	Power System Analysis and Design by B.R. Gupta, S. Chand and Co. New Delhi.
10.	Electrical Power Distribution System by V. Kamraju, Tata McGraw-Hill, New Delhi.

TH:3- AC MACHINES AND SPECIAL ELECTRICAL MACHINES

L	T	P		Course Code: EEPC206	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: EEPC207**			
Credit		**3**		Category of Course : PC	

RATIONALE:

Presently single phase and three phase induction motors, synchronous machines and fractional horse power (FHP) motors are commonly used in modern industries. The Electrical Engineering Technicians has to look after the installation, operation and control of electrical machines in any industries. So the knowledge of electrical machine is very essential in this regard. This subject covers single phase induction motors, three phase induction motor, three phase alternators, synchronous motors and fractional horse power (FHP) motors. This subject deals with the working principles, operation of the above machines. The aim of this course is to help the student to maintain induction, synchronous and FHP machines used in different applications.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Explain the construction and working principle of single phase and three phase induction motors.
- Describe the Torque vs. Speed characteristics of single phase and three phase induction motors
- Explain the different methods of starting and speed control of induction motors
- Describe the construction and working principle of Synchronous Machine
- Explain the performance characteristics of Synchronous Machine
- Discuss the construction and working principle of Special types of motors

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted time(Hours)
I	**Three Phase Induction Motor** 1.1 Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip 1.2 Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor 1.3 Rotor quantities: frequency, induced emf, power factor at starting and running condition 1.4 Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them(numericals) 1.5 Induction motor as a generalized transformer with phasor diagram 1.6 Four quadrant operation, Power flow diagram(numericals) 1.7 Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters 1.8 Speed control methods: stator voltage, pole changing, rotor resistance and VVVF 1.9 Motor selection for different applications as per the load torque-	10

	speed requirements 1.10 Maintenance of three phase induction motors	
II	**Single phase Induction Motors** 2.1 Double field revolving theory 2.2 Principle of making single phase induction motors self-start 2.3 Construction and working of single phase induction motors 2.3.1 Resistance start induction run 2.3.2 Capacitor start induction run 2.3.3 Capacitor start capacitor run 2.3.4 Shaded pole 2.3.5 Repulsion type 2.3.6 Series motor 2.3.7 Universal motor 2.3.8 Hysteresis motor 2.4 Torque-speed characteristics for all of the above motors. 2.5 Motor selection for different applications as per the load torque-speed requirements 2.6 Maintenance of single phase induction motors	9
III	**Three phase Alternators** 3.1 Principle of working, moving and stationary armatures 3.2 Constructional details: parts and their functions 3.2.1 Rotor constructions 3.2.2 Windings: Single and Double layer 3.3 E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor 3.4 Alternator loading 3.4.1 Factors affecting the terminal voltage of alternator 3.4.2 Armature resistance and leakage reactance drops. 3.5 Armature reaction at various power factors and synchronous impedance 3.6 Voltage regulation: direct loading and synchronous impedance methods 3.7 Maintenance of alternators	9
IV	**Synchronous Motors** 4.1 Principle of working /operation, significance of load angle. 4.2 Torques: starting torque, running torque, pull in torque, pull out torque 4.3 Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical). 4.4 Curves and Inverted V-Curves. 4.5 Hunting and Phase swinging. 4.6 Methods of Starting of Synchronous Motor 4.7 Losses in synchronous motors and efficiency (no numerical). 4.8 Applications areas	9
V	**Fractional horse power (FHP) Motors** 5.1 Construction and working 5.1.1 Synchronous Reluctance Motor 5.1.2 Switched Reluctance Motor 5.1.3 BLDC 5.1.4 Permanent Magnet Synchronous Motors 5.1.5 Stepper motors 5.1.6 AC and DC servomotors 5.2 Torque speed characteristics of above motors 5.3 Applications of above motors	8

REFERENCES:

1.	Electric Machines by P.S. Bimbhra, Khanna Book Publishing Co., New Delhi.
2.	Basic Electrical Engineering by V.N. Mittle and Arvind Mittle, McGraw Hill EducationNew Delhi.
3.	Electrical Machines by D. P. Kothari and I. J. Nagrath, McGraw Hill Education. New Delhi.
4.	Electrical Machines by S. K. Bhattacharya, McGraw Hill Education, New Delhi.
5.	Electrical Technology Vol-II (AC and DC machines) by B.L. Theraja, S.Chand and Co. Ltd., New Delhi.
6.	Special Purpose Electrical Machines by S. K, Sen, Khanna Publishers, New Delhi.
7.	Special Electrical Machines by E. G Janardanan, Prentice Hall India, New Delhi.
8.	Electrical Technology by E. Hughes, ELBS.
9.	Electrical Technology by H. Cotton, ELBS.

PR:1- POWER ELECTRONICS LABORATORY

L	T	P		Course Code: EEPC208	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PC	

RATIONALE:

The aim of this course is that the students will get an opportunity to apply the knowledge acquired in the connected theory course and have the experiences, which will enable them to demonstrate essential technical skills needed as an Electrical engineer. This course supports student to maintain the proper functioning of power electronic devices.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Select power electronic devices for specific applications.
- Maintain the performance of Thyristors.
- Troubleshoot turn-on and turn-off circuits of Thyristors.
- Maintain phase controlled rectifiers.
- Maintain industrial control circuits.

DETAILED COURSE CONTENTS

Sl. No.	List of experiments / Practical
1	Test the proper functioning of power transistor.
2	Verify the VI characteristics of IGBT.
3	Verify the VI characteristics of DIAC to determine the break over voltage.
4	Verify the VI characteristics of SCR.
5	Test the variation of R, C in R and RC triggering circuits on firing angle of SCR.
6	Test the effect of variation of R, C in UJT triggering technique.
7	Perform the operation of Class – A, B, C, turn-off circuits.
8	Perform the operation of Class –D, E, F turn off circuits.
9	Use CRO to observe the output waveform of half wave-controlled rectifier with resistive load and determine the load voltage.
10	Draw the output waveform of Full-wave-controlled rectifier with R load, RL load, free-wheeling diode and determine the load voltage.
11	Determine the firing angle using DIAC and TRIAC phase-controlled circuit on output power under different loads such as lamp, motor or heater
12	Test the performance of given SMPS, UPS.

13	Troubleshoot the Burglar's alarm, Emergency light system, Speed control system, Temperature control system.
Atleast ten (10) experiments to be performed by each student.	

REFERENCES:

1	Ramamoorty M., An Introduction to Thyristors and their applications, East-West Press Pvt. Ltd.,New Delhi, ISBN: 8185336679.
2	Sugandhi, Rajendra Kumar and Sugandhi, Krishna Kumar, Thyristors: Theory and Applications, New Age International (P) ltd. Publishers, New Delhi, ISBN: 978-0-85226-852-0.
3	Bhattacharya, S.K., Fundamentals of Power Electronics, Vikas Publishing House Pvt. Ltd. Noida.ISBN: 978-8125918530.
4	Jain & Alok, Power Electronics and its Applications, Penram International Publishing (India)Pvt. Ltd, Mumbai, ISBN: 978-8187972228.
5	Rashid, Muhammad, Power Electronics Circuits Devices and Applications, Pearson EducationIndia, Noida, ISBN: 978-0133125900.
6	Singh, M. D. and Khanchandani, K.B., Power Electronics, Tata McGraw Hill Publishing Co. Ltd,New Delhi, 2008 ISBN: 9780070583894.
7	Zbar, Paul B., Industrial Electronics: A Text –Lab Manual, McGraw Hill Publishing Co. Ltd., New Delhi, ISBN: 978-0070728226.
8	Grafham D.R., SCR Manual, General Electric Co., ISBN: 978-0137967711

PR:1- AC MACHINES AND SPECIAL ELECTRICAL MACHINES LABORATORY

L	T	P		Course Code: EEPC210	
0	0	4			
Total Contact Hours				**Laboratory Assessment**	
Practical		**: 60Hrs**	**Total Marks: 50**	**End Term Exam**	**15**
				Progressive Assessment	**35**
Pre Requisite		**: EEPC217**			
Credit		**2**		**Category of Course : PC**	

RATIONALE:

Presently single phase and three phase induction motors, synchronous machines and fractional horse power (FHP) motors are commonly used in modern industries. The Electrical Engineering Technicians has to look after the installation, operation and control of electrical machines in any industries. So the knowledge of electrical machine is very essential in this regard. This subject covers single phase induction motors, three phase induction motor, three phase alternators, synchronous motors and fractional horse power (FHP) motors. This subject deals with the working principles, operation of the above machines. The aim of this course is to help the student to maintain induction, synchronous and FHP machines used in different applications.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Maintain three phase induction motor used in different applications
- Maintain single phase induction motor used in different applications
- Maintain three phase alternators used in different applications
- Maintain synchronous motors used in different applications
- Maintain FHP motors used in different applications

DETAILED COURSE CONTENTS

Sr. No.	List of Experiments /Practical
1.	Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2.	Connect and run the three phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two)
3.	Perform the direct load test on the three phase squirrel cage induction motor and plot the i) efficiency versus output, ii) power factor versus output, iii) power factor versus motor current and iv) torque – slip/speed characteristics
4.	Conduct the No-load and Blocked-rotor tests on given 3-f squirrel cage induction motor and determine the equivalent circuit parameters.
5.	Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: i) auto-transformer, ii) VVVF.

6.	Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
7.	Perform the direct loading test on the given three-phase alternator and determine the regulation and efficiency.
8.	Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)
9.	Conduct the test on load or no load to plot the 'V' curves and inverted 'V' curves (at no-load) of 3-f synchronous motor.
10.	Dismantling and reassembling of single-phase motors used for ceiling fans, universal motor for mixer.
11.	Control the speed and reverse the direction of stepper motor
12.	Control the speed and reverse the direction of the AC servo motor
13.	Control the speed and reverse the direction of the DC servo motor
Atleast ten (10) experiments to be performed by each student.	

REFERENCES:

Same as EEPC206

PROGRAM ELECTIVE – I (Any One)

TH:4(a)- ELECTRICAL TESTING AND COMMISSIONING

L	T	P		Course Code: EEPE202(a)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

The aim of this course is to help the student to attain the industry-identified competency through various teaching-learning experiences, which will enable them to follow standard safety procedures in testing and commissioning of electrical equipment.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Discuss safety procedures with respect to earthing and insulation of electrical equipment
- Identify proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers
- Explain the process of testing and commissioning of electrical equipment in accordance with IS codes
- Discuss plans for troubleshooting electrical machines.
- Discuss regular preventive and breakdown maintenance.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Electrical Safety and Insulation** Do's and don'ts regarding safety in domestic electrical appliances as well for substation/power station operators Electrical safety in industry/power stations/ substations at the time of operation/ control/ maintenance. Fire detection alarm, fire-fighting equipment. Factors affecting life of insulating materials, classifications of insulating materials as per IS:1271-1958 Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectricabsorption, iii) Megger Insulating oil - properties of insulating oil, causes of deterioration of oil, testing of transformer oil as per IS 1866-1961	9
II	**Installation and Erection** Concept of foundation for installation of machinery. Requirements of foundation for staticand rotating electrical machinery.	9

	Concept of leveling and aligning Procedure for leveling and alignment of direct coupled drive, effects of misalignment Installation of transformer as per I.S.-1886-1967 and procedure of installation of transformer, Requirements of installation of pole mounted transformer Requirements of installation of rotating electrical machines as per I.S. 900 - 1965 Devices and tools required for loading, unloading, lifting, and carrying heavy equipment andprecautions to be taken while handling them	
III	**Testing and Commissioning** Concept of testing, Objectives of testing. Roles of I.S.S. in testing of electrical equipment, Types of tests: Routine tests, type tests, supplementary test, special tests, Methods oftesting - Direct/Indirect/Regenerative testing. Tolerances for the various items for equipment–transformer, induction motor, dc motor, synchronous machines Commissioning: Tests before Commissioning for transformer, induction motor, alternator. Testing of transformer as per I.S.1886- 1967 and I.S.2026- 1962 Testing of three-phase Induction motor as per I.S.325 - 1970. Testing of single-phase induction motor as per I.S.990-1965. Testing of synchronous machines as per ISS Testing of D.C. machines	9
IV	**Troubleshooting Plans** Internal and external causes for failure / abnormal operation of equipment. List of mechanical faults, electrical faults and magnetic faults in the electrical equipment, remedies, applications Use of tools like bearing puller, filler gauges, dial indicator, spirit level, megger, earth tester, and growler. Common troubles in electrical equipment and machines.	9
V	**Maintenance** Causes of failure of electrical machines Preventive maintenance-procedure or developing maintenance schedules for electrical machines. Factors affecting preventive maintenance schedules, Concept of TPM, Pillars of TPM Identification of different types of faults developed such as mechanical/ electrical/ magnetic faults	9

REFERENCES:

1	Deshpande. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines ISBN No8120336453, 9788120336452.
2	Rao, B V S Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equip-ment Vol-I, ISBN No 8185099022
3	Rosenberg. McGRAW-HILL, 1st Edition, May 2003, Maintenance and Repairs, ISBN No9780071396035
4	Sharotri, S. K. Glencoe/ Mcgraw- Hill; 2nd Edition, June 1969; Preventive Maintenance of Electrical Apparatus, ISBN No 10: 007030839X 13: 978-0070308398

TH:4(b)- LINEAR CONTROL SYSTEMS

L	T	P		Course Code: EEPE202(b)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

This course shall introduce the fundamentals of modelling and control of Linear Time Invariant (LTI) systems; primarily from the classical viewpoint of Laplace transforms. The course will be useful for students to build foundations of time/frequency analysis of systems as well as the feedback control of such systems.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Express the basic elements and structures of feedback control systems
- Correlate the pole-zero configurations of transfer functions and their time-domain response
- Apply Routh-Hurwitz criterion, Root Locus, Bode Plot and Nyquist Plot to determine the stability of LTI systems
- Determine the steady-state response, errors of stable control systems
- Design compensators to achieve the desired performance

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Introduction to Laplace Transform.** **Open loop and closed loop control systems:** Feedback principle, Transfer function of LTI systems-Mechanical and Electromechanical systems – Force voltage and force current analogy - block diagram representation - block diagram reduction - signal flow graph - Mason's gain formula - characteristic equation.	9
II	**Control system components:** DC and AC servo motors – synchro - gyroscope - stepper motor - Tacho generator. Time domain analysis of control systems: Transient and steady state responses - time domain specifications - first and second order systems step responses of first and second order systems.	9
III	**Error analysis:** Steady-state error analysis - static error coefficient of type 0, 1, 2 systems - Dynamic error coefficients. Concept of stability: Time response for various pole locations - stability of feedback system - Routh's stability criterion	9
IV	**Root locus and Polar plot:** General rules for constructing Root loci – stability from root loci - effect of addition of poles and zeros. Lag, Lead and Lead-Lag compensators, Nyquist stability criterion-Nichols chart - Non-minimum phase system - transportation lag.	10
V	**Frequency domain analysis:** Frequency domain specifications- Analysis based on Bode plot - Log magnitude vs. phase plot, State space model, State Transition matrix	8

REFERENCES:

1.	Control Systems Engineering by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers.
2.	Automatic Control Systems , by B. C. Kuo
3.	Modern Control Engineering by Katsuhiko Ogata Prentice Hall of India Pvt. Ltd.
4.	Imthias Ahamed T P, Control Systems, Phasor Books, 2016
5.	Control System Components; Gibson J. E., F. B. Tuteur and J. R. Ragazzini, , Tata McGraw Hill,
6.	Gopal M., Control Systems Principles and Design, Tata McGraw Hill,

TH:4(c)- COMMUNICATION TECHNOLOGIES

L	T	P		Course Code: EEPE202(c)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

The aim of this course is to help the student to attain the industry-identified competency through various teaching learning experiences and enable them to use relevant data communication technique.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Identify the different types of data communication equipment and techniques.
- Use relevant digital modulation techniques.
- Interpret the specifications of the data communication media.
- Discuss maintenance of the fibre optics networks for data communication.
- Use OSI model and relevant data communication protocols.
- Discuss wireless network environment.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Data Communication and Modulation** Block diagram of communication system **Types of communication system:** synchronous and asynchronous, simplex, half-duplex, Full duplex, serial and parallel communication **Classification of communication technique:** AM, FM, & PM on the basis of definition, waveform, bandwidth, modulation index **Modulation and demodulation:** Block diagram of AM, FM and PM **Pulse Modulation:** Block diagram for waveform generation of PAM, PWM& PPM, working principle, advantages, disadvantages and applications. Advantages of pulse modulation over AM and FM.	8
II	**Digital Modulation Techniques** **Digital Communication:** Block diagram and working principle, waveforms, strength and limitations. Sampling process Nyquist sampling theorem, quantization process, quantization error, quantization noise. **PCM:** Block diagram, working principle, waveforms, advantages, disadvantages, application of PCM. Principle of ASK, PSK, FSK. Application of ASK, PSK, FSK	8
III	**Data Communication Media** Baud rate, Bit rate, types of errors in data communication and error correction techniques. Types of communication media and frequency band of operation. **Guided media:** Types of cable-twisted pair cable, co-axial cable, fiber optic cable.	8

	Unguided media: Microwave communication, Infrared communication.	
IV	**Fibre Optics** Introduction to Fibre optic communication. Strength and limitations of fiber optic system **Light propagation:** reflection, refraction, Snell's law . **Light propagation through cable:** Mode of propagation, index profile **Fibre optic cables:** cable construction, fibre optics cable modes, single mode, step index fibre, multimode index fibre, multimode graded index fibre, fibre cable losses. **Light source and Detector:** Light emitting diode (LED), Photo Transistor, Laser diode, optocoupler.	**8**
V	**Data Communication Protocols and Interfacing Standard** OSI (Open Systems Interconnection) Reference model Introduction to protocol, FTP, SMTP, TCP/IP, UDP, LAN standards. Introduction to IEEE Standards for LAN and GPIB **RS-232 standard:** Introduction, and working principle Network topologies, introduction star, ring, tree, bus, mesh, hybrid Basic functions of networking devices: modem, switches, routers, repeaters, hubs, bridges, gateway.	**8**
VI	**Advanced Data Communication** Introduction to Wi-Fi and Wi- Max Bluetooth architecture and its layers, Universal serial bus (USB) architecture. Bluetooth and USB	**5**

REFERENCES:

1.	Wayne Tomasi, Electronic Communication System, Prentice Hall of India, ISBN 13:9780130494924
2.	Reynders D., Steve Macky, Wright Edvin, Practical Industrial Data Communications, Newnes publication, ISBN 10:07506639523
3.	Tanenbaum, Andrew S.David J. Wetherall , Computer Networks, Pearson; 5 edition ISBN 13:9788121924252
4.	Kumar A.,Text Book of Communication Engineering, Umesh Publication, ISBN 13:978818114160
5.	A. Kumar,D. Manjunath, Joy Kuri, Communication Networking, Academic Press Publication ISBN 13:9780124287518
6.	Hemant Kumar Garg, Soni Manish, Electronic Communication & Data Communication, UniversityBook House Private Ltd., ISBN 13:9788181980717

PROGRAM ELECTIVE – II (Any One)

TH:5(a)- SENSORS & ACTUATORS

L	T	P		Course Code: EEPE204(a)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

The objective of this course is to understand basics of sensors, actuators and their operating principle. Also this course is to provide information about interfacing of sensors and signal conditioning circuits to establish any control system or monitoring system. The course will also provide knowledge about simulation and characterization of different sensors and finally the students will be able to select sensors for various applications.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Explain the characteristics of sensors and measurement
- Describe principles of various Sensors.
- Explain Pressure and level measuring elements
- Discuss Flow and temperature measuring elements:
- Select various types of actuators

DETAILED COURSE CONTENTS

Unit	Topic/Sub Topic	Allotted Time (Hours)
I	**Introduction to sensors and measurement.** 1.1 Overview of measurement systems: Definition of sensor, Difference between sensor, transmitter and transducer; Primary measuring element: selection, 1.2 static and dynamic characteristics: Range; Response time; Accuracy; Precision; Sensitivity; Dead band; Dead time; Signal transmission: 1.3 Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Standard signal ranges 1.4 Introduction of Electronic transmitter; Pneumatic transmitter; Smart transmitters.	**6**
II	**Principles of various Sensors:** 2.1 Classification of sensors. Characteristics and calibration of different sensors 2.2 Working Principle of Displacement, Position and Motion sensors, Limit switches, Proximity sensors, LVDT, strain gauge, Tacho- generator,. Encoders, Hall sensors, Distance sensors. Light Sensor. Accelerometer, Force, Torque, Tactile sensors, Load cells, Piezoelectric transducer. 2.3 Principle of Piezo Resistive Type; Variable Capacitive Type; Variable reluctance	**10**

	type sensors. Synchros and resolver	
III	**Pressure and level measuring elements:** 3.1 Bourden tube, Bellows; Diaphragm. 3.2 Application of Diaphragm: Capacitance Type, Reluctance Type, Strain Gauge Type and Inductive Type. 3.3 Application of Bellows: Electrical and Piezoelectric pressure transducers, 3.4 McLeod gage, Pirani gage and Ionisation gage. 3.5 Level sensors: Float type, Variable resistive type, Inductive type, Capacitive type.	**10**
IV	**Flow and temperature measuring elements:** 4.1 Flow sensors: Reynolds numbers; Types of Flow meters and principle of flow measurement: 4.2 Differential pressure type: orifices; venturi tubes; flow tubes; flow nozzles; pitot tubes; and Rotameter, Nutating disk & Rotary-vane types. 4.3 Velocity meters: Turbine; Vortex shedding; Electromagnetic and Mass flow meters, Anemometer, Ultrasonic flow meter. 4.4 Temperature sensors: Thermocouples, Thermistor, RTD, Pyrometer.	**10**
V	**Actuators :** 5.1 Definition and Example; selection; Types of Actuators; 5.2 Pneumatic actuator; Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: 5.3 Hydraulic actuator; Control valves: Construction; Valve coefficient or valve sizing; valve characteristics; types of valves; valve selection. 5.4 Electrical actuating systems: Solid-state switches, Solenoids, Voice Coil; Electric Motors; Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.	**9**

REFERENCES:

1.	Patranabis.D - Sensors and Transducer, Wheeler publisher, 1994.
2.	Doeblin, E.O. – Measurement Systems: Application and Design, Mc Graw Hill International
3.	Murthy, D.V.S., Transducers and Instrumentation, PHI, New Delhi.
4.	Newbert, H. K. – Instrument Transducers, Oxford University Press.
5.	D Patranabis. Principles of Industrial Instrumentation, TMH

TH:5(b)- ELECTRICAL ESTIMATION AND CONTRACTING

L	T	P		Course Code: EEPE204(b)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

Electrical installation plays a major role in distributing the electrical energy from electric utilities to consumers. Electrical diploma holders should work as technicians and supervisors for planning, installation and testing of various electrical wiring installations such as residential, commercial and industrial installation schemes. Therefore, the knowledge of electrical estimation and contracting is highly essential for electrical diploma engineers. This subject covers electric installation and safety, estimation and costing, non-industrial installations, industrial installations, public lighting installation, distribution lines and LT substation. The aim of this course is to help the student to design electrical installation with costing for tendering.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Explain the different types of electrical installation
- Illustrate different standard electrical symbols
- Explain different types of electrical wiring systems
- Prepare detail estimate for domestic building, sub-station, service line and distribution panel.
- Design various practical lighting schemes and LT substation

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted time (Hours)
I	**Electric Installation and Safety** 1.1 Scope and features of National electric code 2011 1.2 Types of electrical installation 1.3 Fundamental principles for electrical installation 1.4 Permit to work, safety instructions and safety practices 1.5 Purpose of estimating and costing	8

II	**Estimation and Costing** 2.1 Meaning and purpose of- Rough estimate 2.2 Detailed estimate 2.3 Supplementary estimate 2.4 Annual maintenance estimate and revised estimate 2.5 Factors to be considered while preparation of detailed estimate and economical execution of work 2.6 Contracts 2.6.1 Concepts of contracts 2.6.2 Types of contracts 2.6.3 Contractor 2.6.4 Role of contractor 2.7 Tenders and Quotations 2.7.1 Type of tender 2.7.2 Tender notice 2.7.3 Preparation of tender document, and method of opening of tender 2.7.4 Quotation 2.7.5 Quotation format 2.7.6 comparison between tender and quotation 2.8 Comparative statement 2.8.1 Format comparative statement 2.8.2 Order format 2.8.3 Placing of purchasing order 2.9 Principles of execution of works, planning, organizing and completion of work, Billing of work	10
III	**Non-Industrial Installations** 3.1 Types of Non-industrial installations-Office buildings, shopping and commercial centre, residential installation, Electric service and supply 3.2 Design consideration of electrical installation in commercial buildings 3.3 Design procedure of installation- steps involved in detail 3.4 Estimating and costing of unit 3.5 Earthing of commercial installation 3.6 Design electrical installation scheme of commercial complex. 3.7 Erection, Inspection and testing of installation as per NEC	9
IV	**Industrial Installation** 4.1 Classification of industrial buildings based on power consumption 4.2 Drawing of wiring diagram and single line diagram for single phase and three phase Motors. 4.3 Design consideration in industrial installations 4.4 Design procedure of installation-detailed steps 4.5 Design electrical installation scheme of factory/ small industrial unit 4.6 Preparation of material schedule and detailed estimation 4.7 Installation and estimation of agricultural pump and flourmill	9
V	**Public Lighting Installation** 5.1 Classification of outdoor installations streetlight/ public lighting installation 5.2 Street light pole structures 5.2.1 Selection of equipment 5.2.2 Sources used in street light installations. 5.3 Cables 5.3.1 Recommended types and sizes of cable 5.3.2 Control of street light installation 5.4 Design, estimation and costing of streetlight	9

REFERENCES:

1.	Electrical Design Estimating and Costing by K.B. Raina, S. K. Bhattacharya, New Age International Publisher.
2.	Electrical Estimating and Costing by Allagappan,, N. S. Ekambarram, Tata Mc-Graw Hill Publishing Co. Ltd.
3.	Electrical Estimating and Costing b. Singh, Surjit Ravi Deep Singh, Dhanpat Rai and Sons.
4.	A Course in Electrical Installation Estimating and Costing by J.B. Gupta, S.K. Kataria and Sons.
5.	Code of Practice for Electrical Wiring Installation, Bureau of Indian Standard. IS: 732-1989.
6.	National Electrical Code 2011, Bureau of Indian Standard. SP-30:2011.

TH:5(c)- INDUSTRIAL INSTRUMENTATION AND CONDITION MONITORING

L	T	P		Course Code: EEPE204(c)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		3		Category of Course : PE	

RATIONALE:

The aim of this course is to help the student to attain the industry-identified competency through various teaching learning experiences and enable them to use instrumentation equipment for condition monitoring and control.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Identify relevant instruments used for measuring electrical and non-electrical quantities.
- Identify relevant transducers/sensors for various applications.
- Discuss the use of relevant instruments for measuring non-electrical quantities.
- Explain checking of the signal conditioning and telemetry system for their proper functioning.
- Illustrate the use of data acquisition systems in various applications.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted time (Hours)
I	**Fundamentals of instrumentation** Basic purpose of instrumentation. Basic block diagram (transduction, signal conditioning, signal presentation) and their function. Construction, working and application of switching devices- Push button, limit switch, float switch, pressure switch, thermostat, electromagnetic relay.	4
II	**Transducers** Distinguish between Primary and Secondary, Electrical and Mechanical, Analog and Digital, Active and Passive. Mechanical devices pry. And sec. transducers Advantages of electric transducers Required characteristics of transducers. Factors affecting the choice of transducers Construction and principle of resistive transducer-Potentiometer –variac and strain gauges -No derivation. Only definition and formula for gauge factor Types of strain gauges like unbonded, bonded and semiconductor. Construction and principle of Inductive transducers-L.V.D.T. and R.V.D.T, their applications. Construction, principle and applications of transducers – Piezo-Electric transducer, photoconductive cells, photo voltaic cells.	8
III	**Measurement of Non-Electrical Quantities** **Temperature measurement** - Construction and Working of RTD, Thermistor and Thermocouple, radiation pyrometer, technical specifications and ranges. **Pressure measurement** – Construction and working of bourdon tube, bellow diaphragm and strain gauge, Combination of diaphragm and inductive transducer, Bourdon tube and LVDT, bellow and LVDT, diaphragm capacitance and bridge Circuit. Construction and Working of Speed Measurement by contacting and non-Contact Type- DC tachometer, photo- electric tachometer, toothed rotor tachometer Generator - magnetic pickup and Stroboscope. Construction and Working of Vibration measurement by accelerometer - LVDT accelerometer, Piezo electric type. Construction and Working of Flow measurement by electromagnetic and Turbine Flow meter. Construction and Working of Liquid level measurement by resistive, inductive, Capacitive gamma rays and Ultrasonic methods. Construction and Working of Thickness measurement by resistive, inductive, capacitive, ultrasonic and Nuclear methods.	10

IV	**Signal Conditioning** Basic Concept of signal conditioning System. Draw pin configuration of IC 741. Define Ideal OP-AMPand Electrical Characteristics of OP-AMP. Different Parameters of op-amp:-Input offset voltage, Input offset current, Input bias current, Differential input resistance, CMMR, SVRR, voltage gain, output voltage, slew rate, gain bandwidth. Output, short circuit current. Use of op-amp as inverting, non- inverting mode, adder, subtractor, and Working of Differential amplifier and instrumentation amplifier. Filters: Types of RC filters and frequency response -no derivation. Sample and hold circuits - operation and its application.	8
V	**Data Acquisition System** Generalized DAS- Block diagram and description of Transducer, signal conditioner, multiplexer, converter and recorder Draw Single Channel and Multi-channel DAS- Block diagram only. Difference between Signal Channel and Multi-Channel DAS. Data conversion- Construction and Working of Analog to digital conversion- successive approximation method, ramp type method. Digital to Analog conversion- Construction and Working of binary weighted resistance method. Concept and methods of data transmission of electrical and electronic transmission. Construction and principle of telemetry system and its type - Electrical telemetering system- Digital display device- operation and its application of seven segment display, dot matrix display and concept of 3½, 4½ digits, LED and LCD applications	8
VI	**Condition Monitoring and Diagnostic Analysis** Definition of condition monitoring Insulation deterioration Mechanism- factors affecting occurrence and rate of deterioration, types of stresses responsible for deterioration Different tests on transformer, their purpose, and the necessary condition of machine. Tests on Circuit breaker, purpose and required condition of machine Tests on CT, purpose, item to be tested and required condition of machine. Power factor, capacitance /tan delta test Insulation and Polarization index, DC winding resistance test, Turns Ratio test Tools and equipment used in Condition monitoring	7

REFERENCES:

1.	Sawhney, A.K. Electric and Electronic Measurement and instrumentation, Dhanpat Rai and Co. Author, Nineteenth revised edition 2011 reprint, 2014, ISBN:10: 8177001000
2.	2. Rangan, C.S. G.R.Sharma. andV.S.V.Mani, Instrumentation devices and system, Pen ram International Publishing India Pvt. Ltd. Fifth edition, ISBN:10: 0074633503
3.	3. Mehta, V.K. Electronics and instrumentation, Third edition-S.Chand and company Pvt Ltd Reprint, 2010, ISBN:81-219-2729-3
4.	4. Singh, S.K. Industrial instrumentation and control, Tata McGraw-Hill, 1987. ISBN: 007451914X, 9780074519141.
5.	5. J.G. Joshi, Electronic Measurement and Instrumentation, Khanna Publishing House, New Delhi (ISBN: 978-93-86173-621)

PROGRAM ELECTIVE – III(Any One)

PR:3(a)- ELECTRICAL ESTIMATION AND CONTRACTING LABORATORY

L	T	P		Course Code: EEPE206(a)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	: 15
				Progressive Assessment	: 35
Pre Requisite		:Related PE Course			
Credit		: 2		Category of Course : PE	

RATIONALE:

Electrical installation plays a major role in distributing the electrical energy from electric utilities to consumers. Electrical diploma holders should work as technicians and supervisors for planning, installation and testing of various electrical wiring installations such as residential, commercial and industrial installation schemes. Therefore, the knowledge of electrical estimation and contracting is highly essential for electrical diploma engineers. This subject covers electric installation and safety, estimation and costing, non-industrial installations, industrial installations, public lighting installation, distribution lines and LT substation. The aim of this course is to help the student to design electrical installation with costing for tendering.

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LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Follow National Electrical Code 2011 in electrical installations
- Estimate the electrical installation works
- Estimate the work of non-industrial electrical installations
- Estimate the work of industrial electrical installations
- Prepare abstract, tender, quotation of public lighting and other installations
- Prepare abstract, tender, quotation of low tension (LT) substations

DETAILED COURSE CONTENTS

Sr. No.	List of Experiments / Activities
1.	Prepare a tender notice for purchasing a transformer of 200 KVA for commercial installation.
2.	Prepare a quotation for purchasing different electrical material required.
3.	Prepare a comparative statement for above material Prepare purchase order for the same.

4.	Design drawing, estimating and costing of hall / cinema theater / commercial installation. Prepare report and draw sheet.
5.	Design electrical installation scheme for any one factory / small industrial unit. Draw detailed wiring diagram. Prepare material schedule and detailed estimate. Prepare report and draw sheet.
6.	Estimate with a proposal of the electrical Installation of streetlight scheme for small premises after designing.
7.	Estimate with a proposal of the L.T. line installation. Prepare report and draw sheet.
8.	Estimate with a proposal of the 500 KVA, 11/0.433 KV outdoor substation and prepare a report
Atleast Five (5) activities to be done by each student.	

REFERENCES:

Same as EEPE 204(b)

PR:3(b)- LINEAR CONTROL SYSTEMS LABORATORY

L	T	P		Course Code: EEPE206(b)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs		End Term Exam	: 15
			Total Marks: 50	Progressive Assessment	: 35
Pre Requisite		: Related PE Course			
Credit		: 2		Category of Course : PE	

RATIONALE:

Aim of this course is to provide hands-on experience in using the control system which are developed to learn the fundamental concepts of control systems and control system components. It will also enhance the learning experience of the students in topics encountered in Control Systems using MATLAB software

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Use MATLAB software to study control systems
- Analyze the response of control system by measuring relevant parameters
- Interpret the role of various components in control system
- Compare theoretical predictions with experimental results

DETAILED COURSE CONTENTS

Sr. No.	List of Experiments /Practical
1.	**Using hardware : Implement atleast any four(4)** 1. To study speed Torque characteristics of • AC servo motor • DC servomotor. 2. To study and demonstrate • Simple motor driven closed loop DC position control system. • Simple closed loop speed control system. 3. To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots. 4. To study behavior of 1st order, 2nd order type 0, type 1 system. • Step, ramp and Impulse response of first order systems. • Step, ramp and Impulse response of second order 5. To study • DC potentiometer as error detector. • Synchro transmitter/receiver

	6. To study temperature control system
2.	**Using software (Control System Toolbox), Implement atleast six(6)** 1. Different Toolboxes in software, 2. Introduction to Control Systems Toolbox. 3. Determine transpose, inverse values of given matrix. 4. Plot the pole-zero configuration in s-plane for the given transfer function. 5. Plot unit step response of given transfer function and find peak overshoot, peak time. 6. Plot unit step response and to find rise time and delay time. 7. Plot locus of given transfer function, locate closed loop poles for different values of k. 8. Plot root locus of given transfer function and to find out S, Wd, Wn at given root & to discuss stability. 9. Plot Nyquist plot and identify stability of a system. 10. Plot Bode plot and identify stability of a system
Atleast four (4) experiments using hardware and Six (6) experiments using software to be performed by each student.	

REFERENCES:

Same as EEPE202(b)

PR:3(c)- SENSORS & ACTUATORS LABORATORY

L	T	P		Course Code: EEPE206(c)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Related PE Course			
Credit		2		Category of Course : PE	

RATIONALE:

Knowledge of sensors, are needed for self-realization of a system and actuators, as they are the way through which the control systems act upon the system. The objective of this lab is to impart practical knowledge and hands-on training to students on the characterization, calibration and applications of sensors and actuators.

LEARNING OUTCOMES:

After completion of this laboratory-oriented course, the students will be able to

- Set up testing strategies of different types of sensors and transducers
- Evaluate performance characteristics of sensors
- Show professional skills in applying the knowledge of sensors in real world
- Design a real-life Industrial instrumentation system.

DETAILED COURSE CONTENTS

Sr. No	List of Experiments / Practical
1	Experiment on Load cell
2	Experiment on LVDT, LVRT
3	Study the Characteristics of bourdon gauge
4	Experiment on capacitive level sensor
5	Experiment on RTD, Thermistor and thermocouple
6	Study the application of proximity sensor
7	Experiment on air quality sensors
8	Study the performance of Rotameter and Orifice meter
9	Study the characteristics of encoder fitted with DC motor
10	Study the operation of Synchro
11	Study the characteristics of Pneumatic and Electrically operated control valves
12	Experiment on pneumatic cylinder and direction control valve
13	Study the characteristics of servo motor and stepper motor
Atleast ten (10) experiments to be performed by each student.	

REFERENCES:

Same as EEPE204(a)

PR:3(d)- ELECTRICAL TESTING AND COMMISSIONING LABORATORY

L	T	P		Course Code: EEPE206(d)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Related PE Course			
Credit		2		Category of Course : PE	

RATIONALE:

Electrical testing and commissioning plays a major role in healthy distribution of electrical energy from electric utilities to consumers. Electrical diploma holders should work as technicians and supervisors for planning, installation and testing of different electrical installations such as residential, commercial and industrial installation schemes. Consequently, the knowledge of electrical testing and commissioning is highly essential for electrical diploma engineers. This subject covers electrical safety and insulation, installation and erection, testing and commissioning, troubleshooting plans and maintenance. The aim of this course is to help the student to follow standard safety procedures in testing and commissioning of electrical equipment.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- State safety measures and safety precautions
- Follow safety procedures with respect to earthing and insulation of electrical equipment
- Select proper tools, equipment, for installation, testing, maintenance of electrical machines and transformers
- Commission electrical equipment in accordance with IS codes after testing
- Make plans for troubleshooting electrical machines
- Undertake regular preventive and breakdown maintenance

DETAILED COURSE CONTENTS

Sr. No.	List of Experiments / Practical
1.	Determine breakdown strength of transformer oil.
2.	Perform insulation resistance test on any one motor/transformer.
3.	Prepare trouble shooting charts for electrical machines such as Transformer, D.C. machines, Induction motor, and Synchronous machines
4.	Measure impedance voltage and load losses of three-phase transformer

5.	Find regulation and efficiency of single-phase transformer by direct loading and back-to-back connection method and compare the results.
6.	Determine efficiency of D.C. machine by Swinburne's test.
7.	Determine efficiency of D.C. machine by Hopkinson's test.
8.	Perform reduced voltage running up test on three-phase Induction motor as per I.S.325 -1967.
9.	Measure no load losses and no load current of a transformer as per IS.
10.	Perform no load test on single phase Induction motor for the measurements of no load current, power input, and speed at rated voltage as per I.S.
11.	Perform temperature rise test on single-phase transformer.
12.	Find efficiency of M.G. set
Atleast any ten (10) experiments to be performed by each student	

REFERENCES:

Same as EEPE202(a)

PR:3(e)- POWER SYSTEM SIMULATION LABORATORY

L	T	P		Course Code: EEPE206(e)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

This course provides the students a simulated environment to understand and apply the relevant theoretical concepts. Hence, the theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the related industry oriented competency.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Interpret the normal operation of the electric transmission and distribution systems.
- Maintain the functioning of the medium and high voltage transmission system.
- Interpret the parameters of the extra high voltage transmission system.
- Maintain the functioning of the low voltage AC distribution system.
- Maintain the components of the transmission and distribution lines.

DETAILED COURSE CONTENTS

Sr. No.	List of Experiments / Practical
1.	To study the Power System blocks in MATLAB
2.	To design short and long transmission line using MATLAB.
3.	To study and calculate the transmission line parameters.
4.	To study the corona loss in power distribution system.
5.	To study the proximity and skin effect.
6.	To find ABCD parameters of a model of transmission line.
7.	To study performance of a transmission line under no load condition and under load at different power factors.
8.	To observe the Ferranti effect in a model of transmission line.
9.	To study performance characteristics of typical DC distribution system in radial and ring main configuration
10.	To study mechanical design of transmission line.

REFERENCES:

Same as EEPC208

PR:4- MINOR PROJECT

L	T	P		Course Code: PR202	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 100	End Term Exam	30
				Progressive Assessment	70
Pre Requisite		: Nil			
Credit		2		Category of Course : Project	

RATIONALE:

A Minor project is generally requires a larger amount of effort and more independent work than that involved in a normal assignment. It requires students to undertake their own fact-finding and analysis. The students will select the topic, perform and design work. Minor project is as preparation for the students to take on more responsibilities and bigger project in the future. It is a learning experience, which aims to provide students with the opportunity to synthesize knowledge from different areas of learning, and critically and creatively apply it to real life situations. The leadership quality, co-ordination of job and maintaining good communal harmony is an important factor of this type of activity.

LEARNING OUTCOMES:

After completion of the course, the students will be able to

- Plan a Minor Project
- Execute a Minor Project with team.
- Implement hardware/software/analytical/numerical techniques, etc. based on project requirements.
- Optimize time related works through sharing of work responsibility
- Develop cost awareness and utilisation of fund.
- Prepare a technical report on the project.

GUIDELINES FOR MINOR PROJECT

- Minimum three and maximum five students can form a group for the minor project.
- Project type can include
    - Development of a simple prototype system/product.
    - Investigation of performance of some systems using experimental method
    - Analysis of components/systems/devices using suitable software
    - Investigation of optimum process/material for product development using market survey.
    - Solution for society/industry problems
- Project domain may not be limited to the specific area / discipline.
- Project report to be prepared and submitted by the students with following components:
    1. Title
    2. Objectives
    3. Relevance and significance
    4. Methodology
    5. Analysis-Simulation/experimentation/survey/testing etc.
    6. Result and Discussion
    7. Conclusion

ESSENCE OF INDIAN KNOWLEDGE AND TRADITION

L	T	P		Course Code: AU202	
2	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		**: 30Hrs**	**Total Marks: NA**	**End Term Exam**	**0**
				Progressive Assessment*	**0**
Pre Requisite		**: Nil**			
Credit		**0**		**Category of Course : Mandatory**	

***Mandatory Audit Courses will be assessed only for confirmation of student learning without reflecting in the total scores or Credit.**

RATIONALE:

Considering the need of protecting Indian knowledge and tradition, the diploma level students of Automobile Engineering should be facilitated the concepts Indian traditional knowledge and to make them understand the importance of roots of knowledge system and methods of application in today's life and how to protect traditional knowledge system. Interpretation of the concepts of Intellectual property to protect the traditional knowledge as well as importance of Traditional knowledge in Agriculture and Medicine must be known.

COURSE OUTCOME:

On successful completion of the course, students will be able to:

- Discuss the concepts of traditional Indian knowledge and roots of knowledge system and indigenous knowledge system
- Explain the technique of protection of traditional Indian knowledge
- Discuss legal frameworks of traditional knowledge
- State intellectual property rights
- State traditional knowledge in Different Sectors

DETAILED COURSE CONTENTS

UNIT	TOPIC/SUB-TOPIC	Allotted HRS.
1	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge (Unani / Siddha/ Ayurveda), Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge of Odisha	07
2	Protection of traditional knowledge (TK): The need for protecting traditional knowledge, Significance of TK Protection, value of TK in global economy, Role of Governmentto harness TK.	07
3	Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 andRules 2004, the protection of traditional knowledge bill, 2016.	06
4	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, Geographical Indications (GI).	04

5	Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK	06

REFERENCE BOOKS:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor.
3. Madhya Himalayi Sanskriti mein Gyan, Vigyan evam Paravigyan by Prof PC Pandey.

Suggested Online Link:

Web Links:
1.https://www.youtube.com/watch?v=LZP1StpYEPM
2.http://nptel.ac.in/courses/12110600/