B. TECH IN ELECTRICAL & ELECTRONICS ENGINEERING

COURSE STRUCTURE (R20) SYLLABUS –I-II

Applicable From 2020-21 Admitted Batch

I YEAR - II SEMESTER

S. No.	Course Code	Course Title	Course Category	Hours Per Week			Total Contact Hour	Credits	Scheme of Examination Maximum Marks		
				L	T	P			Internal (CIE)	External (SEE)	Total
1	**2020002**	ENGINEERING MATHEMATICS - II	BSC	3	1	0	4	4	30	70	100
2	**2020006**	APPLIED PHYSICS	BSC	3	1	0	4	4	30	70	100
3	**2020201**	BASIC ELECTRICAL ENGINEERING	PCC	3	0	0	3	3	30	70	100
4	**2020372**	ENGINEERING WORKSHOP	ESC	1	0	3	4	2.5	30	70	100
5	**2020371**	ENGINEERING DRAWING PRACTICE	ESC	1	0	4	5	3	30	70	100
6	**2020071**	APPLIED PHYSICS LAB	BSC	0	0	3	3	1.5	30	70	100
7	**2020273**	BASIC ELECTRICAL ENGINEERING WORKSHOP LAB	PCC	0	0	2	2	1	30	70	100
Total Credits				**11**	**2**	**12**	**25**	**19**	**210**	**490**	**700**

*MC – Satisfied/Unsatisfied

L - Lecture periods, T - Tutorial periods, P - Practical periods

2020002: ENGINEERING MATHEMATICS-II **L T P C**
3 1 0 4

B.Tech. I Year II Semester

Course Objectives: To learn

- Methods of solving the differential equations of 1st and higher order.
- The applications of the differential equations to Newton's law of cooling, Natural growth and decay, etc.
- Concept of Sequence and nature of the series.
- The physical quantities involved in engineering field related to vector valued functions
- The basic properties of vector valued functions and their applications to line, surface and volume integrals.

Course Outcomes: After learning the contents of this paper the student must be able to

Co 1: Identify whether the given differential equation of first order is exact or not

Co 2: Solve higher differential equation and apply the concept of differential equation to real world problems.

Co3: Analyse the nature of sequence and series.

Co 4: Apply the del operator to vector and scalar valued functions.

Co5: Evaluate the line, surface and volume integrals and converting them from one to Another.

UNIT-I: First Order and First-Degree ODE and its applications

Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of natural growth and decay. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Learning outcomes:

- Identify whether the given differential equation of first order is exact or not.
- Apply the concept of differential equation to real world problems.
- Understand the conepts of linear and Non linear differential equations.
- Analyze Exact and Non Exact differential equations.
- Explain formation of differential equations, Homogeneous equations.

UNIT-II: Higher Order Linear Differential equations

Linear differential equations of second and higher order with constant coefficients, RHS term of the type e^{ax} , Sin ax, Cos ax, and x^n , e^{ax} V(x), x^n V(x), method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

Learning outcomes:

- Identify essential characteristics of linear differential equations with constant coefficients.
- Apply higher order DE's for solving some real world problems.
- Understand the differential equations with constant coefficients by appropriate method.
- Analyse Legendre's equation and Cauchy-Euler equation.
- Explain Method of variation of parameters.

UNIT-III: Sequences & Series

Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences. Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test,

p-test, D-Alembert's ratio test; Raabe's test,logarithmic test; Cauchy's Integral test; Cauchy's root test; Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence.

Learning outcomes:

- Identify the Sequence, types of sequences.
- Apply the concept of sequence and series to real world problems.
- Understand the logical knowledge of forming the series.
- Analyzethe nature of sequence and series.
- Explain Alternating series.

UNIT-IV: Vector Differential Calculus

Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives. Solenoidal and Irrotational vectors, Scalar potential functions. Vector Identities.

Learning outcomes:

- Identify scalar and vector point functions.
- Apply Del to scalar and vector point functions.
- Understand the concepts of Solenoidal and irrotational vectors.
- Analyze the physical interpretation of Gradient, Divergence and curl.
- Explain vector identies.

UNIT-V: Vector Integral Calculus

Line integral-Work done, Surface Integrals-Flux of a vector valued function and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Learning outcomes:

- Identify the work done in moving a particle along the path over a force field.
- Apply Greens, Stokes and Divergence theorems in evaluation of double and triple integrals.
- Understand the concepts of Line Integral.
- Analyze the Flux of a vector valued function.
- Explain Vector valued theorems to real world problems.

TEXT BOOKS:

1 B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

2 Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006

3 G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.

REFERENCES:

1. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
2. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

2020006: APPLIED PHYSICS

B.Tech. I Year II Semester

L	T	P	C
3	0	0	3

Course Objectives:

- Students will demonstrate skills in scientific inquiry, problem solving and laboratory techniques.
- Students will be able to demonstrate competency and understanding of the concepts found in Quantum Mechanics, Fiber optics and lasers, Semiconductor physics, optoelectronics and dielectric and magnetic properties and a broad base of knowledge in physics.
- The graduates will be able to solve non-traditional problems that potentially draw on knowledge in multiple areas of physics.
- To study applications in engineering like memory devices, transformer core and electromagnetic machinery.

Course Outcomes: Upon graduation:

- The student would be able to learn the fundamental concepts on Quantum behavior of matter in its micro state.
- The knowledge of fundamentals of Semiconductor devices and their applications.
- Design, characterization and study of properties of optoelectronic devices help the students to prepare new materials for various engineering applications.
- Study about Lasers and fiber optics which enable the students to apply to various systems involved with communications.
- The course also helps the students to be exposed to the phenomena of dielectric and magnetic properties.

UNIT-I: Quantum Mechanics

Introduction to quantum physics, Black body radiation, Photoelectric effect, de-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Heisenberg's Uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional box.

Learning Outcomes:

Understand the fundamental concepts of quantum mechanics.
Explain the physical significance of wave function.
Apply Schrödinger's wave equation for a free particle.
Analyze the particle behavior in different potential regions.
Evaluate the significance of energy values in one dimensional box.

UNIT-II: Semiconductor Physics

Intrinsic and Extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature, Carrier transport: diffusion and drift, p-n junction diode, Zener diode and their V-I Characteristics, Bipolar Junction Transistor (BJT): Construction, Principle of operation, Hall effect.

Learning Outcomes:

Understand the energy band formation of semiconductors.
Explain the properties of n-type and p-type semiconductors.
Apply the Hall effect for various types of semiconductors.
Analyze the various types of diodes.
Evaluate the hall coefficient of semiconductors.

UNIT-III: Optoelectronics

Radiative and non-radiative recombination mechanisms in semiconductors, LED : Device structure, Materials, Characteristics and figures of merit, Semiconductor photodetectors: Solar cell, PIN and Avalanche photodiode and their structure, working principle and Characteristics.

Learning Outcomes:

Understand the basic principle involved in LED.
Explain about various types of photodiodes.
Apply the knowledge on various diodes.
Analyze the working of PIN and Avalanche diodes.
Evaluate the characteristics of diodes.

UNIT-IV: Lasers and Fibre Optics

Lasers: Introduction to Lasers, Coherence, Population inversion, Pumping, Lasing action, Types of Lasers: Ruby laser, Carbon dioxide (CO_2) laser, He-Ne laser, Semiconductor laser; Applications of laser.

Fibre Optics: Introduction, Block diagram of fiber optic communication system, Total internal reflection, Acceptance angle and Numerical aperture, Step and Graded index fibres, Losses associated with optical fibres, Applications of optical fibres.

Learning Outcomes:

Understand about Laser and fiber optics.
Explain the working principle of laser and optical fibers.
Apply optical fibers in communication system.
Analyze the applications of optical fibers in medical, communication and other fields.
Evaluate the laser and fiber optic concepts in various fields.

UNIT-V: Dielctric and Magnetic Properties

Dielectric properties: Introduction to dielectrics, Polarisation, Permittivity and Dielectric constant, Types of polarisation (Qualitative), Internal fields in a solid, Clausius-Mossotti equation, Ferroelectrics and Piezoelectrics.

Magnetic properties: Introduction to magnetism, Magnetisation, permeability and susceptibility, Classification of magnetic materials, Domain theory of ferro magnetism, Hysteresis, Applications of magnetic materials.

Learning Outcomes:

Understand the concept of polarization in dielectric materials.
Explain various types of polarization of dielectrics and classification of magnetic materials.
Apply Lorentz field and Claussius- Mosotti relation in dielectrics.
Analyze the ferromagenetism on the basis of domain theory.
Evaluate the applications of dielectric and magnetic materials.

TEXT BOOKS:

1. Engineering Physics, B.K. Pandey, S. Chaturvedi - Cengage Learing.
2. Halliday and Resnick, Physics - Wiley.
3. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

REFERENCES:

1. Richard Robinett, Quantum Mechanics
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, Mc Graw-Hill inc. (1995).
3. Online Course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Guptha on NPTEL.

2010201: BASIC ELECTRICAL ENGINEERING

B.Tech. I Year II Semester

L	T	P	C
3	0	0	3

Course Prerequisites: Nil

Course Objectives:

- To analyse and solve electric circuits.
- To provide an understanding of basics in Electrical circuits.
- To identify the types of electrical machines for a given application.
- To explain the working principles of Electrical Machines and single phase transformers.

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenins and Norton's Theorems.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain the need of circuit elements. (L2)
- Analyse the resistive circuits with independent sources. (L4)
- Solve D.C. circuits by using KVL and KCL. (L3)
- Apply network theorems for solving D.C. circuit problems. (L3)

Unit-II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power and power factor. Analysis of single-phase ac circuits consisting of R, L, C, and RL, RC, RLC combinations (series only). Three phase balanced circuits, voltage and current relations in star and delta connections.

Learning Outcomes:

At the end of this unit, the student will be able to

- Develop an understanding of the fundamental laws and elements of A.C circuits. (L3)
- Learn the energy properties of electric elements and the techniques to measure voltage and current. (L2)
- Explain the concept of steady state. (L2)

UNIT-III

Transformers: Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Learning Outcomes:

At the end of this unit, the student will be able to

- Demonstrate knowledge of construction and operating principles of single-phase transformers. (L3)
- Determine losses, efficiency, and voltage regulation of a transformer under specific operating conditions. (L5)
- Identify the connections of a three phase transformer. (L3)
- Illustrate the performance characteristics of different induction motors. (L3)

UNIT-IV:

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dcmotor. Construction and working of synchronous generators.

Learning Outcomes:

At the end of this unit, the student will be able to

- Explain construction & working of induction motor - DC motor. (L2)
- Perform speed control of DC Motor. (L3)
- Explain principle and operation of DC Generator & Motor. (L2)

UNIT-V

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand working principles of LT Switchgear components. (L2)
- Perform elementary calculations for energy consumption, power factor improvement and battery backup. (L3)

Text Books:

1. Basic Electrical Engineering - By M.S.Naidu and S. Kamakshaiah – TMH.
2. Basic Electrical Engineering –By T.K.Nagasarkar and M.S. Sukhija Oxford University Press.

Reference Books:

1. Theory and Problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath PHI.
2. Principles of Electrical Engineering by V.K Mehta, S.Chand Publications.
3. Essentials of Electrical and Computer Engineering by David V. Kerns, JR. J. David Irwin Pearson.

Course Outcomes

After completion of this course the student is able to

- Analyse Electrical circuits to compute and measure the parameters of Electrical Energy.
- Comprehend the working principles of Electrical DC Machines.
- Identify and test various electrical switchgear, single phase transformers and assess the ratings needed in given application.
- Comprehend the working principles of electrical AC machines.

2020372: ENGINEERING WORKSHOP

B.Tech. I Year II Semester **L T P C**
1 0 3 2.5

COURSE OBJECT :

1. To Study of different hand operated power tools, uses and their demonstration.
2. To gain a good basic working knowledge required for the production of various engineering products.
3. To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
4. To develop a right attitude, team working, precision and safety at work place.
5. It explains the construction, function, use and application of different working tools, Equipment and machines

UNIT – 1 CARPENTRY & FITTING HOURS :4

Carpentry – Introduction, Carpentry tools, sequence of operations,Trade importance, advantages, disadvantages and applications

Fitting – Introduction, fitting tools, sequence of operations, Trade importance, advantages, disadvantages and applications

LEARNING OUTCOME :

Student should be able to

1. Understand the trade of carpentry and fitting. (L2)
2. Explain the tools involved in manufacturing operations. (L3)
3. Evaluate the applications of carpentry and fitting. (L4)

UNIT – 2 TIN SMITHY AND BLACKSMITHY HOURS :

Tin-Smithy – Introduction, Tin smithy tools, sequence of operations, Trade importance, advantages, disadvantages and applications

Black smithy- Introduction, Black smithy tools, sequence of operations, Trade importance, advantages, disadvantages and applications

LEARNING OUTCOME :

Student should be able to

1. Understand the oldest manufacturing methods. (L2)
2. Describe the sequence of operations involved. (L3)
3. Explain the safety precautions and tools usage. (L4)

UNIT – 3 HOUSE WIRING AND WELDING HOURS :4

House-wiring – Introduction, Electrical wiring tools, sequence of operations and applications (Parallel & Series, Two-way Switch and Tube Light)

Welding Practice – Introduction, electrode, welding tools, and sequence of operations, advantages and applications (Arc Welding & Gas Welding)

LEARNING OUTCOME :

Student should be able to

1. Discuss the topic of Heat engines.(L3)
2. Identify types of Heat engines cycles.(L5)
3. Evaluate the Factors affecting routing procedure, Route Sheet.(L4)

LIST OF EXPERIMENTS:

1. Carpentry
2. Fitting
3. House Wiring
4. Tin smithy
5. Black smithy
6. welding
7.Foundry

TRADES FOR DEMONSTRATION & EXPOSURE:

1.Plumbing
2. Metal Cutting (Water Plasma), Power Tools In Construction And
3. Wood Working

TEXT BOOK :

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal / Anuradha

REFERENCE BOOK :

1. Work shop Manual – P. Kannaiah/ K. L. Narayana/ SciTech
2. Workshop Manual / Venkat Reddy/ BSP

COURSE OUTCOMES :

1. **Explain** the design and model different prototypes in the carpentry trade such as Cross lap joint, Dove tail joint. (L4)
2. **Demonstrate** the design and model various basic prototypes in the trade of fitting such as Straight fit, V- fit. (L4)
3. **Understand** to make various basic prototypes in the trade of Tin smithy such as rectangular tray, and open Cylinder. (L4)
4. **Demonstrate** the design and model various basic prototypes in the trade of Welding. (L4)
5. **Explain** to make various basic prototypes in the trade of Black smithy such as J shape, and S shape. (L4)
6. **Understand** to perform various basic House Wiring techniques such as connecting one lamp with one switch, connecting two lamps with one switch, connecting a fluorescent tube, Series wiring, Go down wiring. (L4)

2020371:Engineering Drawing Practice

B.Tech. I Year II Semester **L T P C**

1 0 4 3

Pre Requisites: Knowledge in dimensions and units, Usage of geometrical instruments and analytical ability

Course Objective:

- The course is aimed at developing basic graphic skills so as to enable them to use these skills in preparation of engineering drawings, their reading and interpretation.
- To prepare the student to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- To get exposure to a CAD package.

Course Outcomes:

1. Familiarize with BIS standards and conventions used in engineering graphics.
2. Draw various engineering curves e.g., ellipse, parabola, cycloids and involutes etc and construct various reduced scales e.g., plain and diagonal scale.
3. Develop the lateral surfaces of simple solids
4. Ability to draw orthographic projections and isometric projections of given engineering components.
5. Visualize different views like elevation and plan for a given line, plane figures or solid objects.
6. Apply drafting techniques and use 2D software e.g., AutoCAD to sketch 2D plane figures.

UNIT – 1 INTRODUCTION TO ENGINEERING DRAWING

Principles of Engineering Graphics and their Significance-Drawing Instruments and their Uses-Conventions in Drawing-BIS -Lettering and Dimensioning.

Geometrical Constructions: Bisecting a Line, Arc. Dividing A Line into 'N' Equal Parts, Construction of Polygons, Division of Circle into Equal Parts (8 And 12)

Construction of Scales: Plain, Diagonal and Vernier Scale.

Conic Sections: Ellipse, Parabola, Hyperbola and Rectangular Hyperbola- General Methods only.

Engineering Curves: Cycloid, Epicycloid, Hypocycloid

Involutes: For Circle, Triangle, Square, Pentagon and Hexagon.

Learning Outcome:

1. To understand the basic standards, conventions of engineering drawing and how to use the instruments in drawing.
2. Learn and draw the various types of curves used in engineering application.

UNIT – 2 ORTHOGRAPHIC PROJECTIONS

Principles- Assumptions- Different Angles of Projection.

Projections of Points- orientation in all the quadrants

Projections of Lines- Parallel, Perpendicular, Inclined to one plane and Inclined to both planes.

Projections of Planes: Surface Parallel, Perpendicular, Inclined to one plane and Inclined to both planes.

Learning Outcome:

1. Knowledge in various planes of projections
2. To draw the front view, top view and side views of the given geometrical elements

UNIT – 3 PROJECTIONS OF SOLIDS

Classification of solids- Axis- Parallel, Perpendicular, Inclined to one plane and Inclined to both planes- Prisms, Pyramids, Cylinder and Cone

Learning Outcome:

1. To understand the various solid types
2. To draw all the views of the given solid in all possible orientations.

UNIT – 4 SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Types of Section Planes, Sectioning Prisms, Pyramids, Cylinders and Cones using various planes.

Development of surfaces of right Regular Solids- Parallel Line Method, Radial Line Method.

Learning Outcome:

1. To identify the cut surfaces and represent the sectional views graphically when the solid is sectioned.
2. To develop the surfaces of solid using various methods.

UNIT – 5 ISOMETRIC PROJECTIONS AND PERSPECTIVE PROJECTIONS

Principles, Isometric Views of Planes, Solids- Box Method, Offset Method, Compound solids, Sectioned Solids. Conversion of Isometric to Multi view projection and vice versa.

Learning Outcome:

1. Knowledge in principles of isometric projection
2. Conversion of isometric to orthographic and vice-versa.

Text Books:

1. N.D.Bhatt, Elementary Engineering Drawing, Charotar Publishers,2012.
2. Basanth Agrawal and C M Agrawal –Engineering Drawing 2e –,McGraw-Hill Education(India) Pvt.Ltd.

References:

1. Engineering graphics with Auto CAD- R.B. Choudary/Anuradha Publishers
2. Engineering Drawing- Johle/Tata Macgraw Hill.
3. K.Veenugopal, –Engineering Drawing and Graphics + Autocad New Age International Pvt.Ltd, 2011.

2020071: APPLIED PHYSICS LAB

B.Tech. I Year II Semester

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES:

- To gain practical knowledge by applying the experimental methods to correlate with the theoretical knowledge of physics concepts.
- To learn the usage of electrical and optical systems for measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills through discussion on basic principles of scientific concepts in a group.

COURSE OUTCOMES:

- Understand the concepts of the error and analysis.
- Explain the different measuring devices and meters to record the data with precision.
- Apply the experimental skills to design new experiments in engineering.
- Analyze the theoretical knowledge and correlate with the experiment.
- Evaluate the various parameters accurately.

List of Experiments:

1.Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.
2. Solar Cell: To study the V-I Characteristics of solar cell.
3. Photoelectric effect: To determine work function of a given material.
4. Light emitting diode: Plot V-I and P-I characteristics of light emitting diode.
5. LASER: To study the V-I characteristics of LASER sources.
6. Optical fibre: To determine the Numerical aperture and bending losses of Optical Fibres
7. Stewart – Gee's experiment:
   Determination of magnetic field induction along the axis of a current carrying coil.
8. Hall effect: To determine Hall co-efficient of a given semiconductor.
9. LCR Circuit: To determine the resonance frequency and Quality factor of LCR Circuit.
10. R-C Circuit: To determine the time constant of R-C circuit.

Note: Any 8 experiments are to be performed

(2020273) BASIC ELECTRICAL ENGINEERING WORKSHOP LAB

I Year B.Tech EEE – II Sem.

L	T	P	C
0	**0**	**2**	**1**

Prerequisite: Basics of Electrical Engineering

Course Objectives:

- To enhance practical knowledge related to different subjects
- To develop hardware skills such as soldering, winding etc.
- To develop debugging skills.
- To increase ability for analysis and testing of circuits.
- To give an exposure to market survey for available components
- To develop an ability for proper documentation of experimentation.
- To enhance employability of a student.
- To prepare students for working on different hardware projects**.**

Course Outcomes: After completion of course, student will be able to

- Get practical knowledge related to electrical
- Fabricate basic electrical circuit elements/networks
- Trouble shoot the electrical circuits
- Design filter circuit for application
- Get hardware skills such as soldering, winding etc.
- Get debugging skills.

List of Experiments

Group-A

1. Verification of Ohms Law
2. Verification of KVL and KCL
3. Verification of Thevenin's Theorem
4. Verification of Norton's Theorem
5. Verification of SuperpositionTheorem
6. Wiring of lamps in Series- and Parallel
7. Electrical switch board connections for various configurations
8. Design and fabrication of reactor/electromagnet for different inductance values
9. Design and Fabrication of Single phase induction/3Phase Motor Stator
10. Star Delta starter wiring for automatic and manual operation

Group-B:

This group consists of electric circuits which must be assembled and tested on general purpose PCB or bread boards.

1. Wiring of distribution box with MCB, ELCB, RCCB and MCCB
2. Wiring of 40 Watts Tube, T-5, LED Metal Halide lamps and available latest luminaries.
3. Assembly of DOL and 3-point starter with NVC connection and over load operation.