

# ***ELECTRAZINE***

A HALF YEARLY MAGAZINE  
THIRTEENTH EDITION JULY 2021



**NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA**

# TECHNICAL

Motor protection



# ENGLISH

Obesity

I have learnt that I deserve

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## FROM THE EDITOR

Dear Reader,

Greetings to you all.

It gives me immense pleasure to present to you the tenth edition of ELECTRAZINE. Publication of the magazine included a lot of planning, organized effort and hard labour. Like the earlier issues of ELECTRAZINE, this issue also includes some valuable technical and literary expressions of our students and faculties, scripted in the form of some amazing writing talents.

I am confident that this magazine would find warm appreciation and welcome for the readers.

**Sumita Deb**

Chief Editor

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## FROM ELECTRATEAM

“

*You learn to rely on a few basic movements and use your voice to the greatest extent possible to convey your emotions. So there was a technical challenge and a responsibility to create a character from behind the task.*

”

-HELENA CARTER

*It gives us a great pleasure and satisfaction to present to you the Tenth edition of the departmental magazine **ELECRAZINE**. This branch magazine is the culmination of efforts put in by the whole editing and designing team.*

*This magazine is intended to evoke a response from you. Our purpose is to use it as your mouthpiece and at the same time present the happenings of the department before you. We seek to provide you with some pages where you can unwind yourself from the daily grinds and the rigors of the technical complexities and let the creative self take over for a while. It is expected to serve as the little excuse or the tiny dose of motivation which will stir the dormant artistic creativity of the students. At the same time it is also the mean by which you can have your opinion heard and your ideas shared.*

*We are indebted to **Dr. PRIYA NATH DAS** and **Dr. SUMITA DEB** for the inspiration and the kind support. A branch magazine owes a lot to the contributors and hence we are also thankful to all those who chipped in with precious contents. We have put in our best in the pursuit of publishing this magazine which would cater to the expectations of the readers but still there is always a scope of improvement and thus feedback and suggestions are always welcome.*

*We hope you all will enjoy as you turn over the leaves of **ELECTRAZINE 13.0!!***



# Message from HOD

*Electrical Engineering Department was started its journey since the establishment of Tripura Engineering College (TEC) in 1965. TEC got converted into NIT, Agartala with effect from 1<sup>st</sup> April, 2006. Over the last few decades, our graduates have been serving the society in key positions and have made tremendous contributions to the development of India in its evolution from an industrial based to a knowledge-based country.*

*The field of Electrical Engineering encompasses many exciting technologies: Microelectronics, HV Transmission, Power Generation etc, which have been the fastest growing and most challenging technologies that enable the development of the modern information-based society.*

*Thus I feel very happy in presenting the tenth edition of ELECTRAZINE on the eve NEW YEAR. I hope this magazine will be enjoyed by all of us as before.*

**Dr. Priya Nath Das**

**HOD, Electrical Engineering**

# TECHNICAL SECTION





# Motor Protection

NAYAN PAUL, 4<sup>TH</sup> YEAR

Due to its low cost and rugged nature most of the motors used in our domestic applications are squirrel cage induction motors. Slip ring induction motors are only used if speed control is required. The major parts of any motor feeder are the contactors and relays. Contactors are the predominant switching devices with a high mechanical and electrical life. Overload relays offer protection against overload and single phasing and can be directly mounted onto the contactors. This makes the motor feeder extremely compact and modular.

MOG motor protection circuit breakers offer the advantage of having both overload and short circuit protection in a single compact unit. This solution is cost effective and ensures savings in panel space.

The most common method of motor starting is either Direct On Line (DOL) or Star – Delta:-

## A) DOL Starting:-

While DOL starting method is simple & most commonly used, care has to be taken while selecting the SCPD & relay. It is recommended to select MCCB & MPCB with magnetic

threshold of at least 12 times of motor full load current for all standard motors & at least 14 times of full load current for high efficiency motors.

### 1) Star - Delta Starting:-

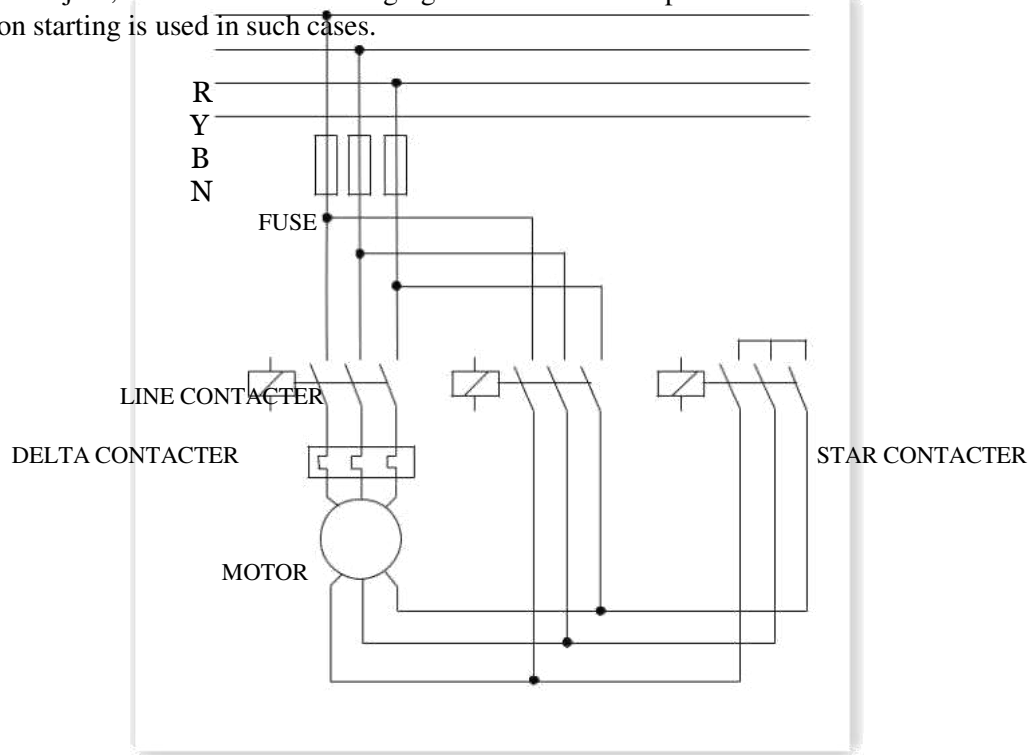
Star Delta starting method is popularly used to reduce the motor starting current. For Star-Delta motor feeders, the motor winding is connected in star. When it reaches a certain speed the motor winding connection is changed to delta. It is of following two types:-

#### a) Open Transition:-

Open transition star delta starting is preferred in majority of the motor starting applications. In open transition starting there is a momentary loss of supply to the motor when the changeover from star to delta takes place. When the ON button is pressed, the star and main contactors get picked and the motor is connected in star configuration. As a result a reduced voltage ( $V_L/3$ ) is applied across motor windings. The motor continues to run in star connection for a period set in the star delta timer. After the time delay, star contactor drops off and delta contactor picks up causing the motor to get connected in delta. There is a pause time of the order 50 - 80 msec configured in every star delta timer. This is to

ensure that delta contactor picks up only after star contactor has fully dropped to prevent the eventuality of a short circuit. When this changeover takes place, the motor sees a zero voltage across its terminals momentarily. During this time the rotating magnetic field across the stator reduces to zero. However the rotor is still spinning and has a magnetic field. This spinning action of the rotor causes a voltage to be induced in the stator determined by the speed of the rotor. This induced voltage across the stator is called the back EMF.

When the motor is now connected in delta full line voltage appears across its terminals. The difference between the back emf and supply voltage causes a high transient current and corresponding high transient torque. Hence the motor experiences a jerk. The magnitude of the transient current depends on the phase relationship between the back EMF and supply voltage at the time of closure. This current peak may reach a value of about  $18I_n$  and a corresponding mechanical jerk, which can be damaging to some critical processes. To avoid this closed transition starting is used in such cases.



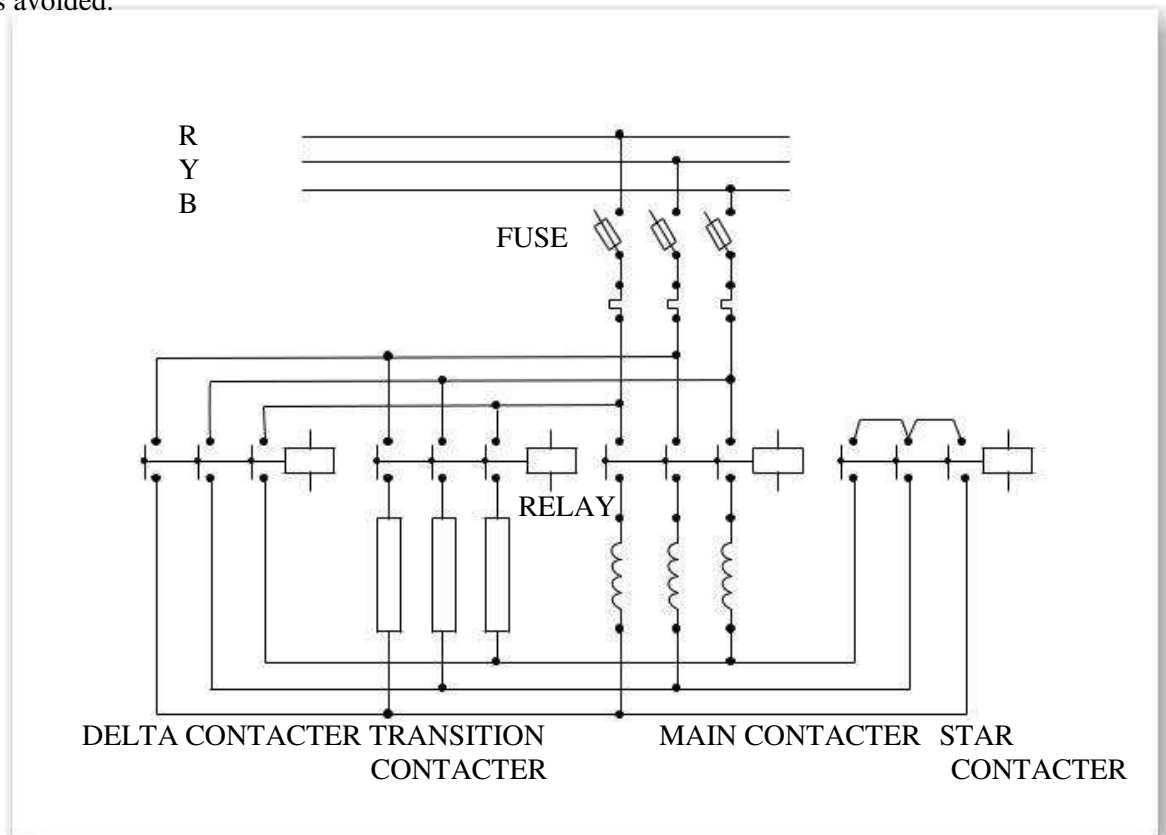
### Circuit diagram of a typical open transition Star Delta (SD) motor starter feeder.

#### b) Close Transition:-

In close transition starter, a smooth changeover from star to delta takes place without the temporary loss of supply to motor thus eliminating the switching transients. This is brought about by employing a fourth contactor along with a set of resistors. When the star contactor is opened, supply is maintained through the motor terminals via the resistors. The resistors are then shorted by the delta contactor when it closes.

#### Advantages :-

- 1) Operation is simple and rugged.
- 2) Transition Peak is reduced to 1.5 times full load current instead of 18 times in open transition.
- 3) The sudden jerk the motor experiences in open transition, while closing the delta contactor is avoided.



### Circuit diagram of a typical close transition Star Delta (SD) motor starter feeder.

#### Disadvantages :-

- 1) More expensive.
- 2) Starter can be bulkier.

### MOTOR PROTECTION :-

The main purpose of motor protection system is to prevent excessive temperature built up in the windings because of over-current and short-circuit current. More importantly, the protection devices should be co-ordinated.

#### A) OVERCURRENT PROTECTION

Following are the reasons for over-current.

1. Overloading
2. Single Phasing
3. Voltage Imbalance

### **Thermal Overload Relay:-**

Thermal overload relay should protect the motor against single phasing and overloading or blocked rotor condition. At the same time, it should withstand starting current for a duration equal to the starting time of the motor. A relay of appropriate trip class can be selected by comparing 'locked rotor current withstand time' for the motor with maximum trip time. For example, for a motor with 'locked rotor current withstand time' of 15 seconds, the relay should have trip time less than 15 seconds at a current equal to locked rotor current.

New generation of thermal overload relays incorporating 'differential mechanism' provide excellent protection against phase unbalance and phase failures even when motor is not running at full load. Unbalanced voltages result in high unequal currents in stator windings and consequently higher temperature rise. Though balanced voltages are preferred, in some applications, voltage unbalance is unavoidable and some derating might be necessary. Where a motor is derated, selection of overload relay should take into account the derating factor.

### **SHORT CIRCUIT PROTECTING DEVICE:-**

Though they operate instantaneously but by the time SCPD interrupts short circuit current, certain amount of fault energy passes through the protected circuit. All the downstream devices and cables in the protected circuit are subjected to stresses corresponding to this energy.

The two important parameters which indicate the extent of stresses generated by short circuits are 'I<sub>t</sub> let through' and 'cut-off current'. 'I<sub>t</sub> let through' signifies thermal stresses. 'Cut-off current (I<sub>c</sub>)' is indicative of electro-dynamic stresses that various devices and links / cables will have to withstand. Lower 'I<sub>t</sub> let through' and 'cut-off current' indicate a more efficient SCPD and hence better short circuit protection.

Motor protection circuit breakers (MPCBs) combine short circuit and overload protection in a single compact unit.

### **Co-ordination of Thermal Overload Relay & SCPD**

#### **What is Co-ordination?**

Co-ordination means matching the characteristics of SCPD and down stream equipment to ensure that the let-through energy and peak cut-off current do not rise above the levels that the circuit can withstand.

IEC / IS / EN specifications require that thermal overload relays and SCPD are co-ordinated to ensure that they operate satisfactorily under all load and fault conditions

#### **Discrimination :-**

To understand various considerations for proper co-ordination, time-current characteristics of thermal overload relay (curve B), H.R.C. fuse (curve C), MCCB with only instantaneous release (curve D) and MPCB (curve E) are superimposed on motor starting characteristics (curve A) in Fig. 3b, 4b and 5b. Intersection of characteristics of thermal overload relay and Fuse / MCCB is termed as 'cross-over point' and corresponding current as 'cross-over current' I<sub>co</sub>.

Following points are to be ensured while selecting components to have properly co-ordinated motor protection:

- 1) Contactor rating (AC-3) should be more than or equal to motor full load current (if application is AC-3 duty)
- 2) Thermal overload relay of appropriate 'Trip Class' is selected. Time current characteristics of the relay should remain above motor starting characteristics as shown in Fig. 3b and 4b
- 3) For fault currents lower than 'cross-over current I<sub>co</sub>', relay will respond faster than SCPD and hence contactor will interrupt the fault current. Fault currents higher than I<sub>co</sub> will be interrupted by SCPD. Hence, rating of contactor is so chosen that I<sub>co</sub> is less than rated breaking capacity of the contactor

4) Relay and contactor should be able to withstand  $I_{co}$  for a duration equal to trip time of the relay. IEC / IS / EN standards require that the contactor should be able to withstand at least current equal to 8 times AC-3 rating (6 times for ratings higher than 630A) for 10 seconds

5) While using MCCB or MPCB, attention needs to be given to motor peak starting current. To avoid nuisance tripping of MCCB/MPCB during starting, instantaneous release is chosen as 13 times the full load current of the motor. This thumb rule assumes motor starting current equal to 6 times full load current

### **Type 1 and Type 2 Co-ordination in Motor Feeders:-**

Selection of components involves co-ordination of characteristics of various devices i.e. of the overload relay & of short circuit protection device of the motor feeder.

**Type “1”** co-ordination requires that under short-circuit conditions, the contactor or the starter shall cause no danger to persons or installation. The motor feeder may not be suitable for further service without repair and replacement of parts.

**Type “2”** co-ordination requires that under short-circuit conditions, the contactor or the starter shall cause no danger to persons or installation and shall be suitable for further use. However contact welding is recognized

Recommended combination needs to be proven through short-circuit tests as

- 1) **Co-ordination with  $I_{sc}$  Prospective current** :- It is the highest short circuit current which can exist in a particular electrical system under short circuit conditions. It is determined by voltage and impedance. The protective device must be selected with an interrupting rating that exceeds the prospective short circuit current.
- 2) **Conditional short-circuit current**:- It is the maximum fault current that the feeder can withstand for a specified period of time. It is declared by the manufacturer.

# NON-TECHNICAL SECTION





# OBESITY

DR. SUMITA DEB,  
ASSISTANT PROFESOR

Along with a surge of adrenaline, today's fast-paced, high-stressed living brings a host of other problems, Obesity being one of the chief concerns. Obesity is basically a life style disorder. It manifests as an excess of fat in the body. This fat invades all tissues and organs of the body indiscriminately. It can be accounted as an adverse consequence of the rapid technological advances made by man. Some very common causes include:

1. Easily available and cheap junk food.
2. Lack of adequate physical exercise and leisure activities centered around television and laptops
3. Improved transportation facilities and mechanization of jobs.

Added to these is our genetic makeup and body metabolism both of which provide the ideal environment for obesity to proliferate. Obesity basically occurs when our body consumes more calories than it burns. In the past, many people thought that obesity was simply caused by overeating and under-exercising, resulting from a lack of will power and self-control. Although these are significant contributing factors, doctors recognize that obesity is a complex medical problem that involves genetic, environmental, behavioral, and social factors. All these factors play a role in determining a person's weight.

Obesity is determined by the body mass index (BMI) of a person. The BMI of an Indian ranges between 18-23 kg/m<sup>2</sup>. BMI above 30 kg/m<sup>2</sup> is classified as obese. The health problems associated with obesity are numerous. It's a health hazard. Someone who is 40% overweight is twice

as likely to die prematurely as is a normal-weight person. Obesity has been linked to several serious medical conditions, including:

- Coronary heart disease and stroke.
- High blood pressure.
- Diabetes (Type-II in particular).
- Cancer.
- Gallbladder disease and gallstones.
- Osteoarthritis.
- Gout.
- Gastroesophageal reflux disease.
- Breathing problems, such as sleep apnea and asthma.

Obese people are often subjected to public ridicule due to their weight, thus leading to psychological disorders such as depression, low self-esteem, discrimination, difficulty finding employment, and reduced quality of life.

**Prevention:** Gaining knowledge about obesity, encouraging a more active and healthy lifestyle and educating children and parents about the ill-effects of obesity might help to curtail the spread of this disorder.

**Treatment:** Actively treating those already suffering from obesity prevents many complications, early disabilities and death. Dieting and physical exercise are the mainstays of treatment for obesity. Diet quality can be improved by reducing the consumption of energy-dense foods such as those high in fat and sugars, and by increasing the intake of dietary fiber. Medical management of obesity involves various types of drugs to be taken under careful medical supervision. The only proven method to do is obesity or bariatric surgery which involves altering the digestive system of the person in such a manner that the feeling of hunger diminishes and satiety lasts longer. However, it would be best to consult a physician before attempting any such surgery.

Instead of postponing what one must do, it is time to get cracking on obesity. It works slowly and silently giving the sufferer a false sense of security. Tackling obesity involves both prevention and treatment.

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# *I HAVE LEARNED THAT I DESERVE*

BHASWATI MEDHI,  
PH.D SCHOLAR

When I was growing up, my parents never spoke to me about what I “deserve”. They spoke to me a lot about what was “expected”. They were very clear about that.

They expected me to be tough, hard-working, well-read and smart. They expected me to help others, especially those struggling on the margins. They expected me to go to temple every now and then so that I would feel thankful to the God for whatever I had and had really nothing to complain about. They expected me to hold my head up and keep walking forward no matter what.

They expected me to stand up when any elderly walked into a room, something I continued still. The list of their expectations went on and on. And along the way, their expectations of me slowly became my own.

But over time, another word crept into my life. Slowly at first, even timidly, because for me the word and the concept felt foreign, maybe even embarrassing.

**That word was ‘deserve’. To think you “deserve” something when others have so little, felt arrogant and selfish – as in, who do you think you are?!!**

But I’ve come to understand that there is power in the idea of deserving.

For example, if you’re a hard worker, you deserve to be appreciated and respected by those you work with. That’s not asking too much. And if you work a lot, you deserve rest. My parents wouldn’t like me saying that, but it’s true. Resting your body and your mind isn’t lazy, it’s being smart. You and your body deserve to rest, mentally and physically, so you can be healthy and then work some more!

You deserve to be treated kindly by your friends, family and significant others. As I say to my brother over and over, “You deserve my respect”. And as I say to him, “So do I. So look me in the eye when you talk to me, and don’t you dare text at the dinner table!” I realized that if we don’t treat ourselves as if we deserve these things, it’s hard for others to see that actions like those are important.

**So what do you deserve? That’s up to you. I can only answer with what I have come to believe I deserve.**

I deserve to be happy. Much of that is in my control, but just knowing that I deserve it has helped me be happier. And being treated kindly and respectfully starts with how I treat myself.

I deserve to take rest and take breaks. That’s why I go to Guwahati, my parent’s place, even if for 2 days, every once in a while, amidst my busy lifestyle. I’m not yet at the position where I can say I deserve a really long vacation, but I’m working toward that “deserve”.

I’m no longer embarrassed to admit I deserve these things, too. I deserve to live in a safe place. I deserve to love and be loved. I deserve the right to dream again. Yes, I do. Dreams are not for twenty-somethings. Dreams are for all of us at any age.

I deserve to grieve in the manner that works for me. If that’s longer than others would like, so be it. I deserve to have people around me who tell me the truth, lift me up, and want the best for me. I deserve to take out some time for myself, if that means to read a good book or to take a nap or to go out to lunch with friends – that’s fine!

I deserve to laugh as much as I want.

I deserve to not know. That’s right. Until I know, I deserve to be unsure or uncertain of how I feel about something or someone. It’s okay. I deserve to express my opinions, and I don’t deserve to be attacked for what I said, for who I am, for what I believe. I deserve the right to change my beliefs once I’ve seen they hurt me or hold me down, or when I discover a better way.

The list goes on, and it can also grow and change. In fact, I expect it to. I hope it will. I deserve that.

I write all these in the hope that you all will think about what you all deserve. I hope you will allow space in your life and your mind to have this conversation with yourself, way earlier than I had mine. It’s not selfish or arrogant. It’s a way to be kind and loving to you.

This thing called life is a magical journey. According to me, it doesn't always make sense. It's filled with uncertainty, joy, struggle, surprises, disappointments, and rewards. It isn't always fair and clean. You deserve to design your life the way it works for you and then redesign it if you want to.

That's what I've come to expect. That's what I've learned I deserve.

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# FIFA WORLD CUP 2018: A RUSSIAN RENDEZVOUS



SUBHRANIL DATTA,  
1<sup>ST</sup> YEAR

Football appeals to the masses around the world like no other game does. Images from around the globe over the past weeks serve as an overwhelming proof of the World Cup fever. The pictures of several kids at a backstreet of Rio De Janeiro having a ball as huge murals of Neymar and Jesus loom over them, or the self taught sculptor who carves out giant images of football stars on the beach in Puri, India- they all reflect the united colours of football.

At the opening ceremony of the World Cup 2018, the Russian president Vladimir Putin upheld the unifying nature of the game as he welcomed “the big, strong, multi-national, football family from all over the world” to Russia. From Moscow’s whopping Luzhniki stadium to the marvellous Fisht stadium in Sochi and the quaint Kaliningrad stadium, standing alone on the Oktyabrsky Island, these arenas have seen an outburst of footballing fans brought together by their collective love for the game.

With great footballing nations like Italy, Chile, Netherlands, failing to even qualify for the tournament in Russia, everyone looked forward to a battle between the other international heavyweights. However, billions bore testimony to Germany crashing out of the World Cup group stage after defeat by South Korea. Lionel Messi and Argentina were knocked out of the world cup with Messi only a mere shadow of his otherwise colossal talented self. Spain went from pre tournament favourites to crashing out on penalties against a far more superior Russian side. Sweden, despite lacking standouts, had a superb run in the tournament until they lost to England at the quarter finals. The English team may have suffered a despondent defeat against Croatia in the semi-finals but this young English side delivered the country’s best world cup performance in 28 years.

To the horde of lovers of this game, one doesn’t need to be from a participating nation to soak in the spirit of the football mania. How else does one explain the madness of places like Kolkata and Kerala

in a cricket-obsessed India where football fans stay divided into Brazil and Argentina camps for months and worship foreign players – like Messi or Ronaldo – as if they were their own? Kolkata, the Mecca of Indian football, has always led from the front when it comes to exhibiting its crazy passion for the game.

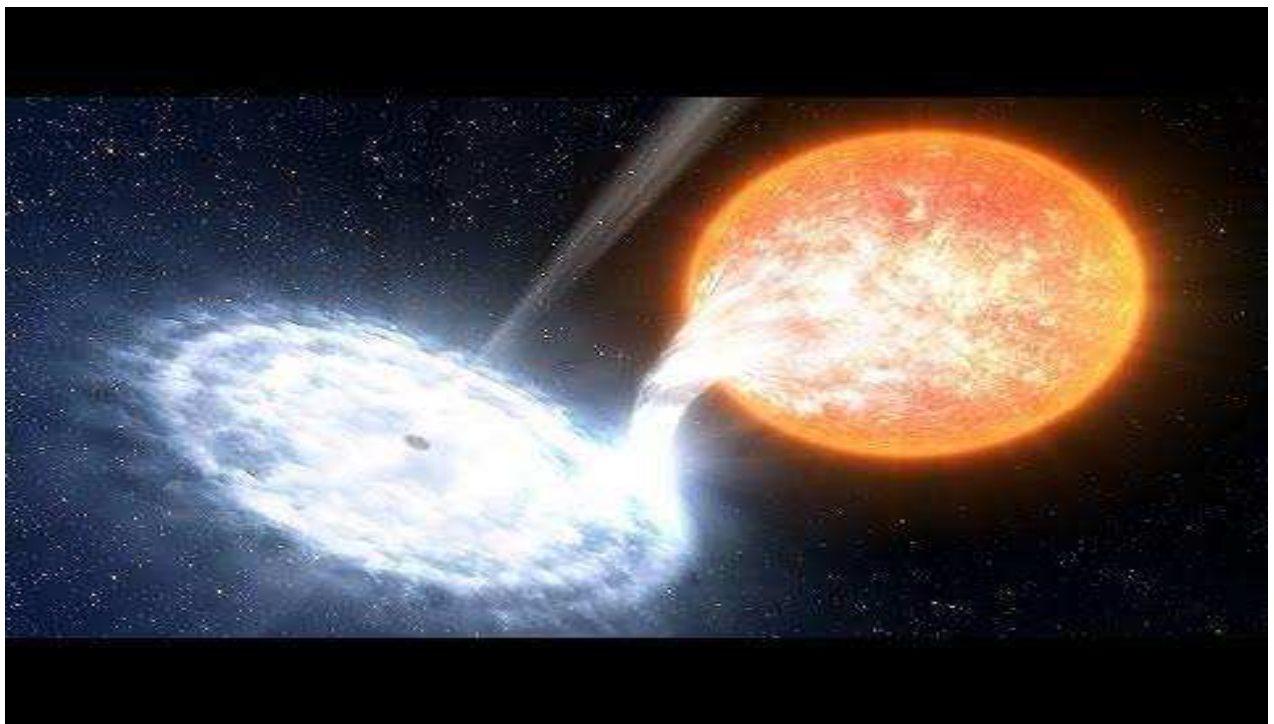
The Messi-Ronaldo frenzy may have ended early on in the tournament but the billions who tuned into the games weren't left dispirited as the antics of Kylian Mbappe, Lukaku, Harry Kane, Juan Quintero, breathe new life into the fans of the game across the world. Mbappe's brace against Argentina is stuff that dreams are made of. Ante Rebic has emerged a breakout footballer for Croatia post a disappointing run in Brazil in 2014. The loss against Croatia is a heartbreak for England as they have produced one of the best young sides in the past few years but this brand new English side has gained a legion of new fans courtesy of their great performance.

Croatia has a population of about 4 million people - the second smallest in the tournament after Uruguay. Following a poor start in the semi finals against England, The *Blazers* rallied from behind to win the match 2-1 in extra time thanks to a goal from Mario Mandzukic. The victory for Croatia is ground breaking as they have registered a place in the world cup finals for the first time. The 62 games over 30 days has produced some exciting contests that managed to shine the spotlight on a new generation of players while burnishing the reputation of some of the stars. A global audience in billions will be tuning into the final match as Croatia will be looking forward to ending their "Cinderella story" on a history-making win against a formidable French side who will be hoping for their second world cup win. May the best team emerge victorious.



# THE GOD PARTICLE

RISHIRUP CHAKRABORTY, 2<sup>ND</sup> YEAR



The discovery of this 'God Particle' was a break through in the field of Astro-Physics.

A new particle with a mass of 125 Gev was discovered in 2012. It was later confirmed to be the Higgs Boson (God Particle).

The **Higgs boson** is an elementary particle in the Standard Model of particle physics. First suspected to exist in the 1960s, it is the quantum excitation of the **Higgs field**, a fundamental field of crucial importance to particle physics theory unlike other known fields such as the electromagnetic field, it is

scalar and also has a non-zero constant value in vacuum. The question of the existence of the Higgs field became the last unverified part of the Standard Model of particle physics, and for several decades, was considered "the central problem in particle physics".

In Layman's terms,

There are two kinds of statistics that particles follow, one discovered by Mr. Fermi and one discovered by Mr. Bose. The ones that do what Mr. Fermi says they do are called fermions and the ones that do what Mr. Bose says they do are called bosons.

Mr. Higgs' boson helps explain why mass-energy and space-time are not actually separate entities but two ways of perceiving the unified field.

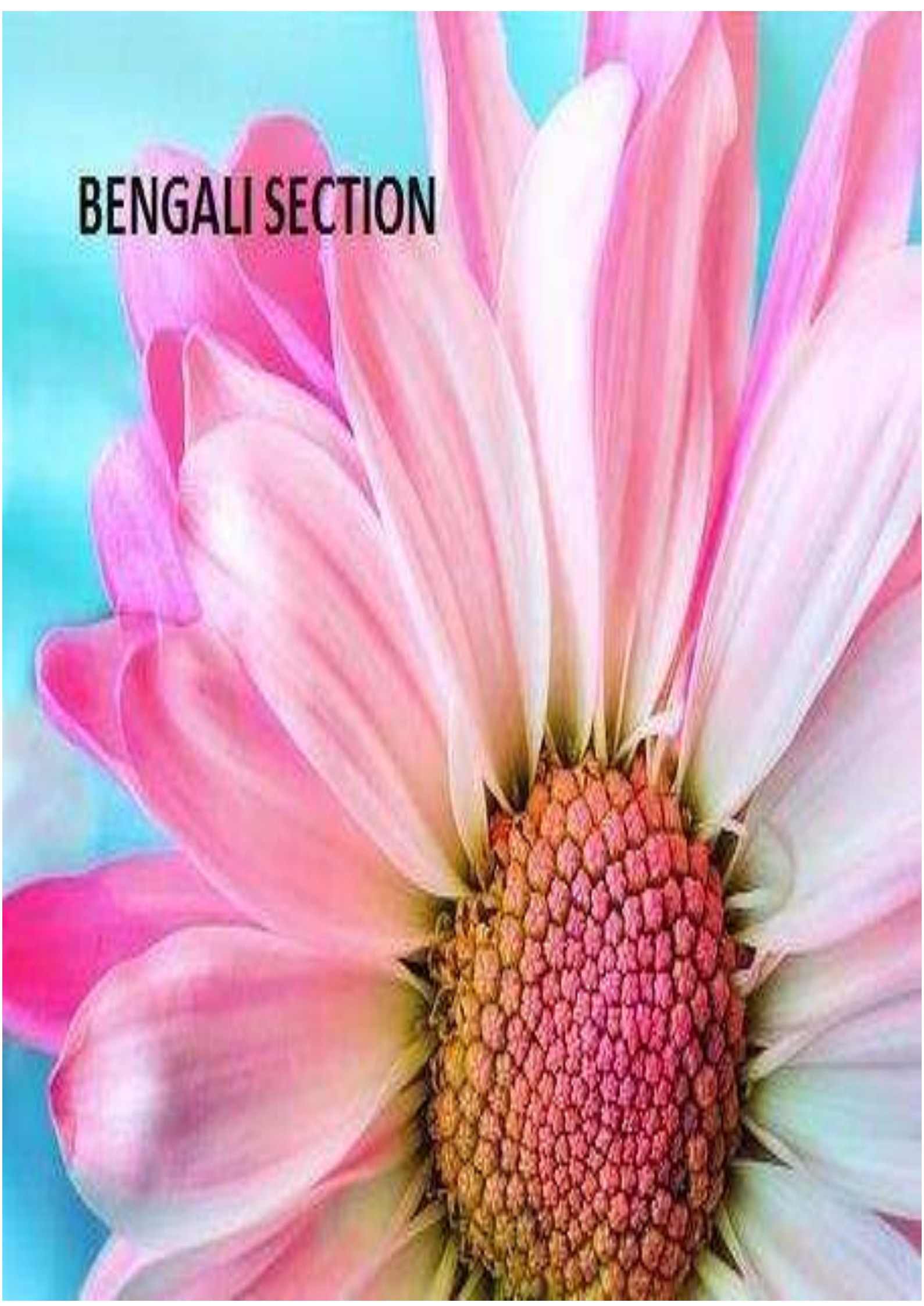
The Higgs Boson explains why some particles have mass. The problem of where mass comes from is complicated because mass is strongly connected to gravity, and no theory of gravity plays nice with the currently popular model of particle physics. Gravity doesn't appear in quantum equations, so it can't explain the motion of big objects for which gravity is important; and the non-realism of quantum theory doesn't appear in Einstein's theory so he can't explain the motion of small objects for which non-realism is important.

Before Mr. Higgs came along, all our equations for particles were symmetrical, so the mass value on one side of the equation was always canceled by the value on the other side. The Higgs field induces a spontaneous symmetry breaking, which leaves mass on one side of the equation and not the other.

The Higgs boson is named after Peter Higgs, one of six physicists who, in the 1964 PRL symmetry breaking papers, proposed the mechanism that suggested the existence of such a particle. On 10 December 2013, two of the physicists, Peter Higgs and Francois Englert, were awarded the Nobel Prize in Physics for their work and prediction (Englert's co-researcher Robert Brout had died in 2011 and the Nobel Prize is not ordinarily given posthumously). Although Higgs's name has come to be associated with this theory, several researchers between about 1960 and 1972 independently developed different parts of it. In mainstream media the Higgs boson has often been called the "God particle", from a 1993 book on the topic the nickname is strongly disliked by many physicists, including Higgs, who regard it as sensationalistic.



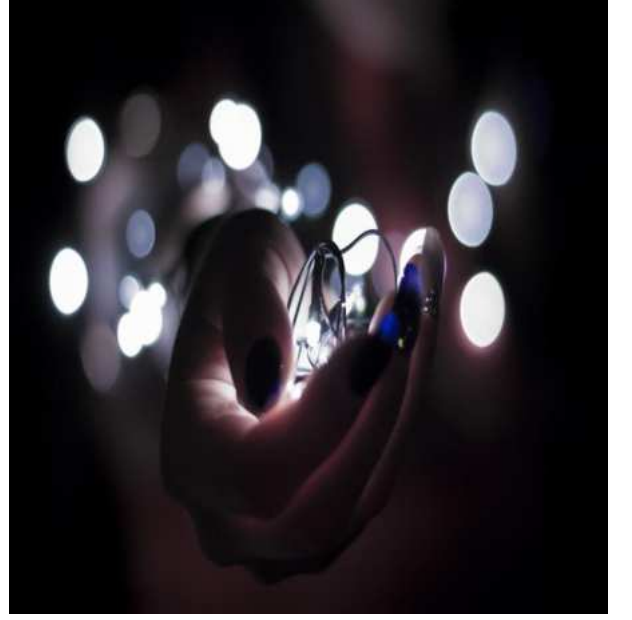
# BENGALI SECTION



বৈমাত্র্যেয়  
সৌমেশ চ্যাটার্জী

(১)

একরাশ কালো মেঘ, শহরের এটাই ফেম  
সময় পেলে সময় অসময়ের প্রেম  
ছোট্ট মেয়ের অঙ্গীকার আমিও বড় হবো  
আর তারপর নতুন ভালোবাসা, আর যা কিছু শুভ  
একদিন আমিও ভালবাসবো তোমায়  
সেদিন কেউ বকবে না আমায়  
কালো সিগারেট আর সময় একসাথে শেষ হয়  
তুমি আর তোমার প্রেমিক, তাই স্বার্থের অপচয়  
সুন্দরী মেয়েরা সব শেয়াল নেকড়ের আশায়  
ভাবি আর বলি আয় পাগল ঘরে ফিরে আয়।



(২)

চেয়েছি অনেক, অপ্রয়োজনীয় যত  
সহায় তুমি, তাই হিসাব নাও নি কখনো  
আজ শুধু সত্যের টান, দাসানুদাস আমি  
নিরুদ্ভিগ্নতা, হোক বা আলোকবর্ষ  
হিসাব চেওনা মা, সম্বলটুকু দিলাম  
ভক্তের ভক্ত যত, যদি বা কাল আসে  
মন্দির-মসজিদ যত, একলা থাকে যেন  
তোমার আশিষ সহায়  
নিজ সন্তান সম  
শুধু শতাব্দী শেষে ঘরে ফিরতে চাই।



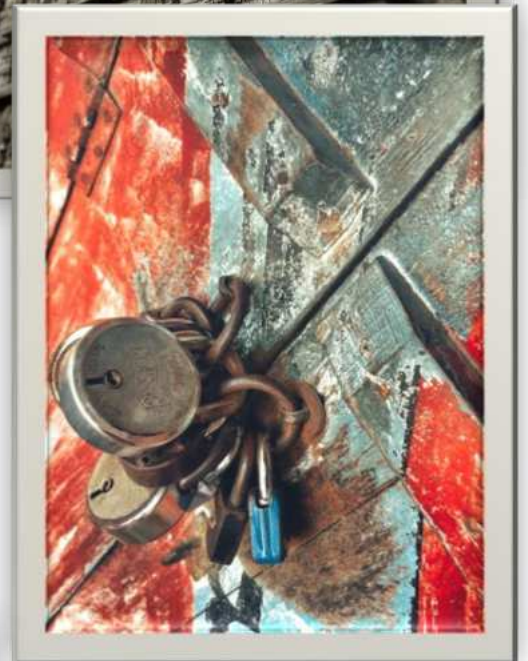


PHOTOGRAPHY



ANKUR BISWAS, 3<sup>RD</sup> YEAR

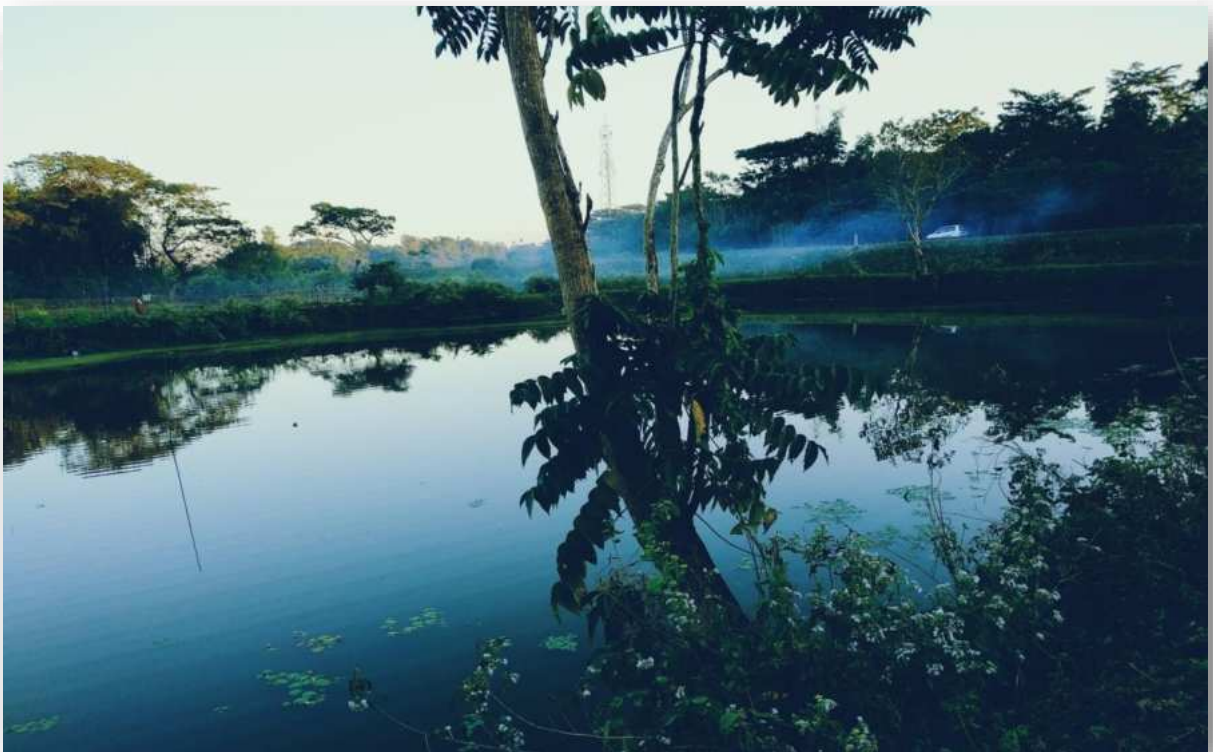




E. THARUN, 2<sup>ND</sup> YEAR



NABANITA DAS, 4<sup>TH</sup> YEAR





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