NEWSLETTER
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 12 (MAY - AUGUST 2023)

Welcome to the Newsletter e-Science Putra. This issue presents the research activities from May to August 2023 which highlight the latest research findings by the selected faculty members.

LICHENS: A REMARKABLE INDICATOR OF POLLUTION

Dr. Shahrizim Zulkifly
Department of Biology, Faculty of Science,
Universiti Putra Malaysia
Expertise: Lichenology, Phycology, Microbiology, Environmental Biotechnology
Email: shahrizim@upm.edu.my

Lichens are an organism unlike another. Lichens are a symbiotic mutual relationship between a photobiont (green algae or cyanobacteria) and a mycobiont (fungus). Lichens are the pioneer of new territories such as newly formed larva islands. Living together, they are able to protect each other while making the other component thrive in new lands. Unfortunately for lichens, they grow very slowly, about 1 mm per year. The body of the lichen or the thallus is porous, enabling them to capture particles of the air, accumulating them in their thallus. This acts as an advantage by having air-borne particles of nutrients to be accumulating to the lichens as nutrients. And, this could be a bane, to the lichen itself, as air-borne particles could contain air polluting compounds such as soot, heavy metals and compounds of acid rain. From this particular trait of growing slowly and accumulating chemical compounds and acid rain, the lichens are usually susceptible to air pollution (Rosli et al., 2019).

Lichens can be very colourful depending on the mycobiont components. They can be orange, various hues of green, grey as well as black (Figure 1). If you notice, in the lowlands, lichens are quite similar. The beautiful lichens grow best in non-polluted, cool montane forest, with abundant sunshine. In the mountains is where you can see the diversity of lichens thrive (Zulkifly et al., 2011). There, the pollution is less, the air is damp and with plenty of sunshine. The algae component of the lichens needs the sun's radiation for photosynthesis, resulting in carbohydrates as food. The mycobiont 'traps' the algae component as their own, it is said to be equivalent to humans rearing cows for their own benefit. The mycobiont protects the fragile algae component, making them hydrated as well as providing the needed nutrients for growth (Zulkifly et al., 2011).

Lichens accumulate heavy metals and other chemical compounds. Most lichens are sensitive to air pollution, making them suitable to be a bioindicator of pollution. Certain lichens are not as sensitive to air pollution, as you can see some selected lichens can be found in cities. Studies have shown that their diversity correlates to the pollution of the air. An index of lichen diversity with pollution is called IAP (Index of Atmospheric Pollution). Rosli & Zulkifly (2022) have studied the pollution levels (IAP) at different elevations in Gunung Jerai. They found that interestingly, different elevations of Gunung Jerai correspond to different levels of pollution (Figure 2).

The diversity of lichens is affected by air pollution as well as anthropogenic activities. In some parts of Gunung Jerai, human activities such as mass biking ascending the hills, has destroyed the trails and habitats of trees in the forest, which affect the lichen diversity. In some levels of Gunung Jerai, mass gathering of people and camping, has inadvertently affected the pristine conditions of Gunung Jerai. The study has also found, however, that Gunung Jerai recorded better IAP scores than the adjacent city which is Sungai Petani (Rosli et al., 2019). Nevertheless, numerous efforts have been made by the State Forestry Department and other agencies to preserve the Gunung Jerai area. It is hoped that the information will help the local authorities to continue preserving Gunung Jerai for biodiversity conservation and for future generations.

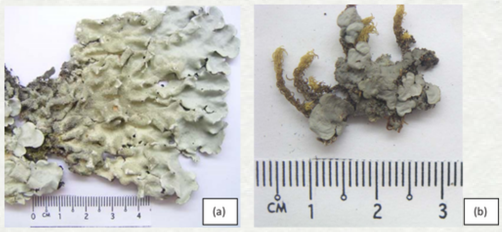


Figure 1: Selected lichens collected at different altitudes of Gunung Machincang, Langkawi Island, Kedah (a) *Parmotrema tinctorum* (b) *Coccocarpia pellita* (Zulkifly et al., 2011).

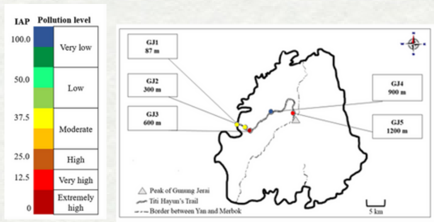


Figure 2: IAP graphical representation of Gunung Jerai 300 m elevations based on Titi Hayun sampling traill (Rosli & Zulkifly, 2022)

References

Rosli, N. S., & Zulkifly, S., Zaharudin, N. A., Mat Lazim, N.N.F., Ali, A. & Go, R. Lichens diversity and index of atmospheric purity of selected sites in Kedah, Malaysia (2019). Malayan Nature Journal 71(4) 467-473.

Rosli, N. S., & Zulkifly, S. (2022). Application of Index of Atmospheric Purity (IAP) along elevation gradients in Gunung Jerai, Kedah, Malaysia. Environmental Monitoring and Assessment, 194(7), 496.

Zulkifly, S., Kim, Y.S., Abdul Majid, M., and Merican, A.F. (2011). Distribution of Lichen Flora at Different Altitudes of Gunung Machincang, Langkawi Islands, Malaysia. Sains Malaysiana 40(11): 1201-1208

NEWSLETTER
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 12 (MAY - AUGUST 2023)

FROM WATERMELON PEELS TO CARBON QUANTUM DOTS

Dr. Mazliana Ahmad Kamarudin
Department of Physics,
Faculty of Science, Universiti Putra Malaysia
Expertise: III-V-Low Dimensional Semiconductor Nanostructures
Email: mazliana_ak@upm.edu.my

The increase in the population has an impact on the increase in solid waste. Food waste, including waste peels or agricultural crops, makes up the greatest portion of the total solid waste in Malaysia. Waste peels or crops are an environmental burden that are typically disposed in landfills without being treated. In some cases, it has been recycled to make biofuel such as oil palm, durian, bananas, and pineapple. As part of the strategy to reduce the amount of solid waste, this motivates us to recycle watermelon waste peels, as a precursor to produce carbon quantum dots (CQDs). The use of biomass as a carbon precursor has benefits over artificial carbon sources, including lower cost, greater availability of raw materials, improved environmental friendliness, and solution of waste management.

Development on nanotechnology increase rapidly therefore small and fluorescent materials are in high demand. CQDs are fluorescent nanoparticles with the diameter size less than 10 nm. It has a potential to be used in various application such as in agricultural, bio-imaging and optoelectronics devices. CQDs shows great potential to fulfil these characteristic due to their ability to tune the size, energy bandgap, absorption wavelength and functionality.

Our research group are exploring the effect of carbon concentration, solvent and doping towards the colloidal stability and the effect of exciton emission. The optical properties were mainly analysed using photoluminescence (PL) and UV-Vis spectroscopy while the morphology was characterised using HRTEM. From the PL,the emission of CQDs is in the visible spectrum and the average size of CQDs is 6.89 ± 0.8 nm.

Recently, our group won the best video and booth award in Malaysia Green Innovation Competition X Green Renewable Energy organised by Universiti Teknologi Malaysia.

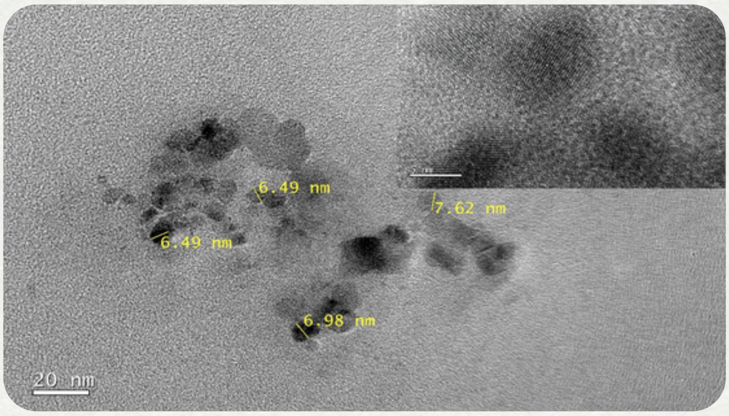


Figure 1: The morphological image of CQDs via HRTEM.

Figure 2: Students from Bachelor of Materials Science (Honours), Department of Physics won the best video award during innovation exhibition at UTM.

Figure 3: Students at booth innovation exhibition.

NEWSLETTER
e-SCIENCE PUTRA
UPM UNIVERSITI PUTRA MALAYSIA BERILMU BERBAKTI
AGRICULTURE | INNOVATION | LIFE
ISSUES 12 (MAY - AUGUST 2023)

GREEN SYNTHESIS OF NANOPARTICLES AND ITS POTENTIAL APPLICATIONS

Dr. Ernee Noryana Muhamad
Department of Chemistry
Faculty of Science, Universiti Putra Malaysia
Expertise: Heterogeneous Catalysis, Material Science
Email: ernee@upm.edu.my

The green synthesis of nanoparticles is getting widely recognized these days due to its simplicity and environmentally friendly nature. This method utilizes plant extract, particularly plant leaf extract, which is known to contain various phytochemicals such as terpenoids, flavonoids, polyphenols, alkaloids, and carboxylic acids [1]. These components are capable of reducing metal salts into metal nanoparticles and also acting as stabilizing agents. The use of plant extract also eliminates the necessity of using harmful reducing agents because it generates fewer adverse effects than chemical or physical methods. In addition, this approach is not time-consuming, and the plants are mostly readily available.

Recently, many researchers have employed the green synthesis process for the preparation of metal or metal oxide nanoparticles via plant leaf extracts to further explore their various applications. Metallic nanoparticles (e.g., silver, titanium, and gold) and metal oxide nanoparticles (e.g., zinc oxide, copper oxide, and iron oxide) have been reported to show vast applications ranging from catalysts to antimicrobial activity, chemical sensors, drug delivery, optoelectronic devices, pharmaceutical products, etc [2].

We carried out a green synthesis of iron oxide nanoparticles ((Fe_2O_3 NPs) using *Murraya koenigii* leaf extract. The synthesized nanoparticles have shown significant catalytic activity in the photodegradation of methylene blue (Figure 1). This result shows iron oxide as a promising candidate for the purification of wastewater contaminated with dyes from textile industries. In another study, titanium dioxide nanoparticles (TiO_2 NPs) extracted from m*oringa oleifera* leaves-based nanocomposite thin film was developed to detect cadmium ions in an aqueous solution.

The proposed Au/TiO_2-CNC thin film based SPR sensor also showed good selectivity towards cadmium ions compared to zinc and mercury ions as shown in Figure 2.

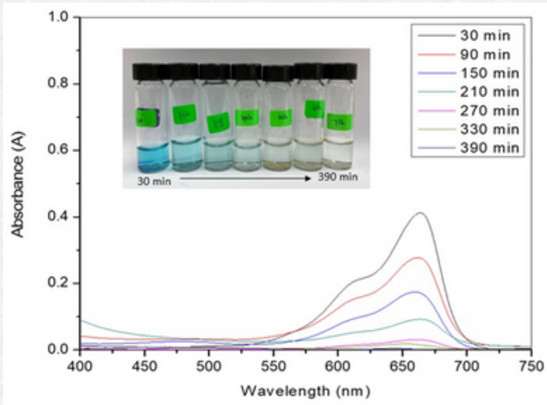


Figure 1: Degradation of methylene blue as a function of time using iron oxide nanoparticles synthesized using *Murraya koenigii* leaf extract.

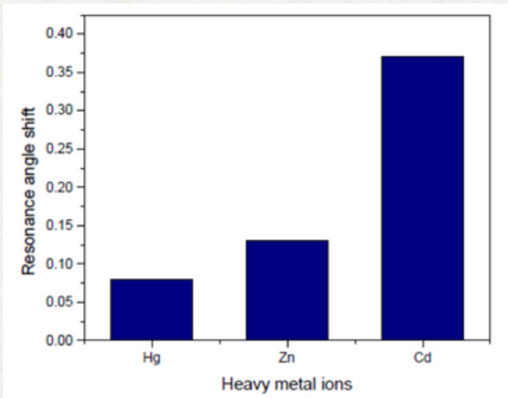


Figure 2: Selectivity of the Au/TiO_2-CNC thin film to Cd^{2+} relative to the other heavy metal ions, such as Zn^{2+} and Hg^{2+} with a concentration of 1 ppm [3].

References

1. Priya, K., Naveen, V., Kaur, K., & Sidhu, A. K. (2021). Green synthesis: An eco-friendly route for the synthesis of iron oxide nanoparticles. Frontiers in Nanotechnology, 3, 655062.

2. Bukhari, A., Ijaz, I., Gilani, E., Nazir, A., Zain, H., Saeed, R., Alarfaji, S. S., Hussain, S., Aftab, R., & Naseer, Y. (2021). Green synthesis of metal and metal oxide nanoparticles using different plants' parts for antimicrobial activity and anticancer activity: A review article. Coatings, 11 (11), 1374.

3. Nur Alia Sheh Omar, Ramli Irmawati, Yap Wing Fen, Ernee Noryana Muhamad, Faten Bashar Kamal Eddin, Nur Ain Asyiqin Anas, Nur Syahira Md Ramdzan, Nurul Illya Muhamad Fauzi, Mohd Adzir Mahdi (2022). Surface refractive index sensor based on titanium dioxide composite thin film for detection of cadmium ions. Measurement, 187, 110287.

N E W S L E T T E R
e-SCIENCE PUTRA
UPM UNIVERSITI PUTRA MALAYSIA BERILMU BERBAKTI
AGRICULTURE | INNOVATION | LIFE
ISSUES 12 (MAY - AUGUST 2023)

ELECTROSPUN POLYMER NANOFIBERS AND THEIR APPLICATIONS

Assoc. Prof. Dr. Norizah Abdul Rahman
Department of Chemistry
Faculty of Science, Universiti Putra Malaysia
Expertise: Polymer Chemistry, Electrospinning
Email: a_norizah@upm.edu.my

Electrospinning is a simple and versatile technique for producing polymer nanofibers. The electrospinning process involves an electrohydrodynamic process, in which a polymer droplet from a polymer solution or polymer melt is electrified to produce a polymer jet, followed by stretching and elongation to generate polymer fibers. Electrospun fiber diameters in the range of micrometers to nanometers. Although electrospun materials are predominantly polymer-based, ceramics, metallics, bioactive particles, and their combinations can be introduced into the fibers and subsequently be part of the final nanocomposites.

Electrospinning has advanced to generate nanofibers with various secondary structures, such as porous, hollow, or core-sheath structures. These nanofibers' surfaces can be further functionalized with a variety of molecular species or nanoparticles during or after the electrospinning process.

Furthermore, by manipulating the alignment, stacking, and/or folding of electrospun nanofibers mats, they can be assembled into well-ordered arrays or hierarchical structures. These attributes render electrospun nanofibers highly suitable for a wide range of applications, including DNA sensors (Figure 1) [1], controlled drug release (Figure 2) [2], the production of carbon nanofibers, and activated carbon nanofibers as adsorbents for heavy metals and contaminants of emerging concerns (CECs) [3].

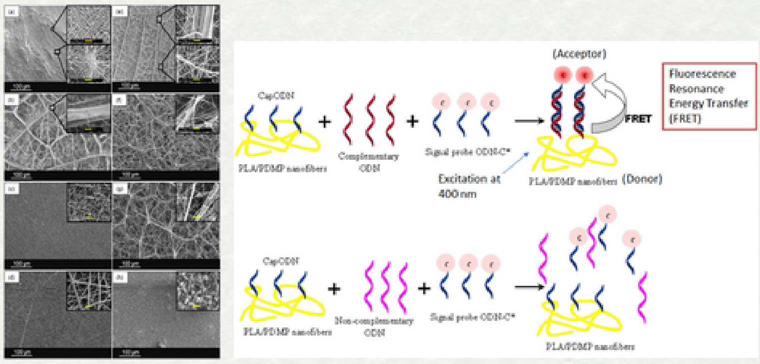


Figure 1: Electrospun PDMP/PLA nanofibers and illustration of the working mechanism of ODN sensing with PDMP/PLA fibers [1].

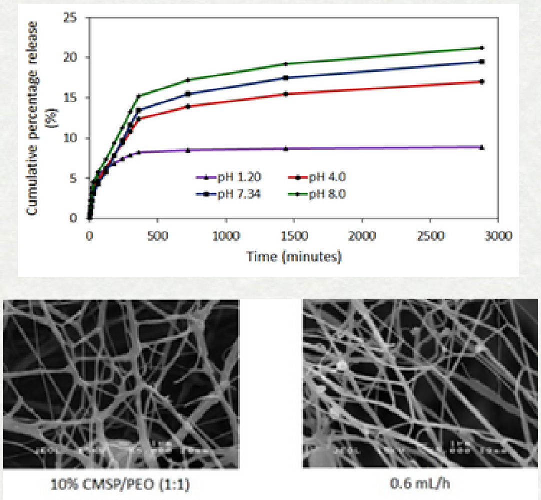


Figure 2: Effects of pH on the release of MB from CMSP/PEO hydrogel nanofibers [2].

References

1. Abdul-Rahman, N., Gulur-Srinivas, A.R., Travas-Sejdic, J. 2014. Spontaneous stacking of electrospun conjugated polymer composite nanofibers producing highly porous fiber mats. Synthetic Metals, 191, 151–160.

2. Mohd-Kanafi N, Abdul-Rahman N, Rosdi NH, Bahruji H. 2019. Hydrogel nanofibers from carboxymethyl sago pulp and its controlled release studies as a methylene blue drug carrier. Fibers, 7(6), 56.

3. Nordin NA, Abdul-Rahman N, Abdullah AH. 2020. Effective removal of Pb (II) ions by electrospun PAN/sago lignin-based activated carbon nanofibers. Molecules 25(13), 3081.

NEWSLETTER
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 12 (MAY - AUGUST 2023)

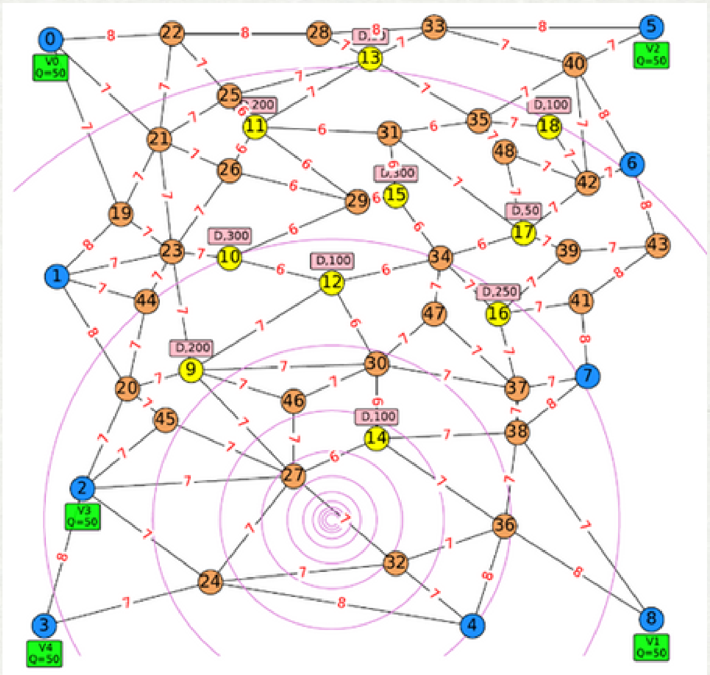
MULTI DEPOT DYNAMIC VEHICLE ROUTING PROBLEM WITH STOCHASTIC ROAD CAPACITY FOR EMERGENCY MEDICAL SUPPLY DELIVERY IN HUMANITARIAN LOGISTICS

Prof. Dr. Lee Lai Soon
Department of Mathematics and Statistics,
Faculty of Science, Universiti Putra Malaysia
Expertise: Operational Research, Artificial Intelligence
Email: lls@upm.edu.my

The occurrence of disasters throughout the world has led to various negative impacts including famine, outbreak of diseases, poverty, and loss of life. The impact of disasters in underdeveloped countries would be worse, as they are often without sufficient resources when dealing with the aftermath of disasters. For a landlocked country like Nepal that suffered from a 7.8 magnitude earthquake on April 25, 2015, and lost nearly 9,000 lives, the need for an efficient relief aid operation is even more dire. The problems observed include limited transport vehicles, congested single point of supplies collection, and uncertainties in route options as well as road facility sustaining continuous damages.

As part of humanitarian logistics research for emergency medical supply delivery during disaster, the modelling and solution of a multi depot dynamic vehicle routing problem with stochastic road capacity is proposed. Based on the chaotic setting from a disaster event, the model and solution are analysed through a decision support system where the proposed model is based on Markov decision processes modelling framework as part of reinforcement learning solution approach.

Through this model, multi objectives, multi depot, multi trip, and split delivery among homogeneous fleet of vehicle are addressed. In addition, a stochastic road capacity distribution where its mean deteriorates over time is also depicted in the problem. To solve the proposed model, an approximate dynamic programming approach is applied focusing on the lookahead approach. Specifically, a post decision state – rollout algorithm is adopted.



References

Anuar, W.K.; Lee, L.S.; Seow, H.-V.; Pickl, S.A. 2021. Multi-depot vehicle routing problem with stochastic road capacity and reduced two-stage stochastic integer linear programming models for rollout algorithm. Mathematics 9, 1572.

Anuar, W.K.; Lee, L.S.; Pickl, S. 2022. Benchmark dataset for multi depot vehicle routing problem with road capacity and damage road consideration for humanitarian operation in critical supply delivery. Data in Brief 41, 107901.

Anuar, W.K.; Lee, L.S.; Seow, H.-V.; Pickl, S.A. 2022. Multi-depot dynamic vehicle routing problem with stochastic road capacity: An MDP model and dynamic policy for post-decision state rollout algorithm in reinforcement learning. Mathematics, 10, 2699.

N E W S L E T T E R
e-SCIENCE PUTRA
AGRICULTURE | INNOVATION | LIFE
ISSUES 12 (MAY - AUGUST 2023)

LINEAR DIOPHANTINE EQUATION

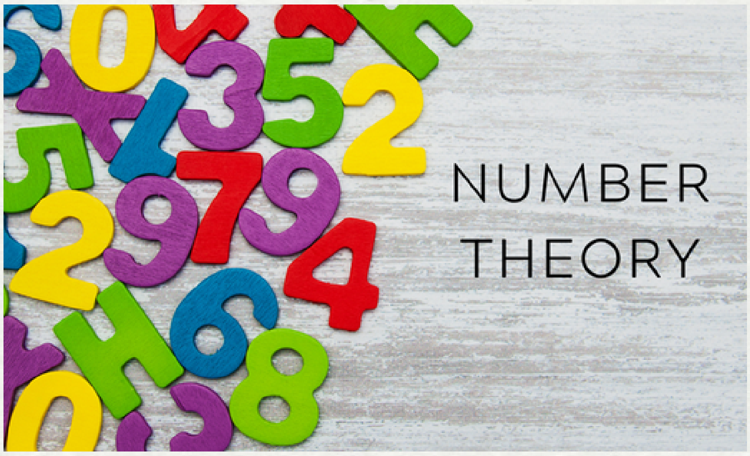
Dr. Mohamat Aidil Mohamat Johari
Department of Mathematics and Statistics,
Faculty of Science, Universiti Putra Malaysia
Expertise: Number Theory
Email: mamj@upm.edu.my

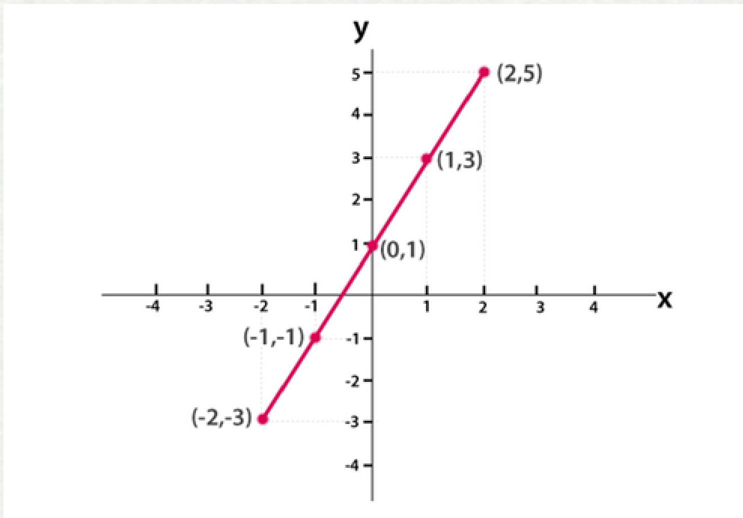
Diophantine equation is a type of equation with coefficients of integer numbers whose solution is sought from a group of integer numbers as well. It is the oldest activity in the study of mathematics. This type of equation is named after an ancient Greek mathematician, Diophantus who wrote about a type of equation whose solution is limited to integer numbers only. The solution to a linear equation will take all the coordinates that lie on the straight line it represents. However, here only coordinates where the x and y values are integers will be considered as solutions to the linear Diophantine equation.

In equation $ax + by = c$, a, b and c are fixed integers and x and y are variables whose integer values we want to find so that both satisfy this equation. That is, the x and y values are the solution to the equation. Geometrically, this effort is equivalent to finding the coordinates (x, y) of integers on the straight line $ax + by = c$ in the xy plane. Of course, before we start trying to find a solution, we need to make sure whether it has a solution or not.

If so, are there many solutions? For example, the equation $2x + 4y = 6$ has a solution which is $x = 1$ and $y = 1$. Also $x = 5$ and $y = -1$ is also the solution. On the other hand, $2x + 4y=7$ has no integer solution. In the case of $2x + 4y = 6$ which has an integer solution, we find the greatest common divisor of the x coefficient and the y coefficient which is (2, 4) = 2 with 2 dividing the constant 6. On the other hand, in the case of $2x + 4y = 7$, we see the greatest common divisor the x coefficient and the y coefficient which is (2, 4) = 2 do not divide 7.

Linear equation $ax + by = c$ has a solution if $(a,b)|c$ and has no solution if $(a,b)\nmid c$. In [3], we discussed a method of obtaining a solution to the linear Diophantine equation in two to five variables of the form $ax + by = c$, $ax + by + cz = d$, $ax + by + cz + dw = e$ and $ax + by + cz + dw + ev = n$.





References

Burton, D. M. 2011, Elementary Number Theory, 7th edition Mc Graw Hill.

Durbin , J. R. 2009, Modern Algebra An Introduction, 6th edition, John Wiley & Son. Inc.

Mohd Atan, K, A, and Mohamat Johari, M. A., 2022, Persamaan Diofantus Linear, Jurnal Asas Ilmu Matematik, 1(4) 35-51. Pustaka Ilmu Matematik.

Science is much more than just a body of KNOWLEDGE.
It is a way of THINKING.

eISSN 2805-4512

9772805451004

FACULTY OF SCIENCE, UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR DARUL EHSAN, MALAYSIA
+603 97696601/6602/6603 www.science.upm.edu.my fs_tdps@upm.edu.my