



**Marri Laxman Reddy  
Institute of Pharmacy**

(Approved by AICTE & PCI,  
New Delhi, JNTUH Affiliated)

Dundigal -Gandimaisamma (V)&(M)  
Medchal Dt, Hyderabad  
Telangana State - 500043



**Sri Marri Laxman Reddy**

**Chairman**  
**MLR Group of Institutions**

He has been in the field of education for more than three decades. He is an exemplary personality and extraordinary visionary and a constant inspiration to the younger generation. He is a veteran athlete of international repute. He emphasizes the importance of physical health for academics and overall personality development.

**Sri Marri Rajshekar Reddy**

**Founder-Secretary**  
**MLR Group of Institutions**

He is a person of great acumen and remarkable abilities. He is a dynamic leader and strives hard to make every dream a reality. He is an initiator, innovator, and executor of novel plans for the progress of the institutions. He is the motivational and driving force of all the activities in the campus.



*“Confidence and Hard work is the best medicine to kill the disease called failure.— It will make you a successful person.”*

– Dr. A. P. J. Abdul kalam

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## PRINCIPAL'S DESK

### Transformation:



**Dr. K. S. Murali Krishna**  
Professor & Principal

Throughout the course of history, disease outbreaks have ravaged humanity, sometimes changing the course of history and, at times, signaling the end of entire civilizations. These diseases are dating from prehistoric to modern times right from Prehistoric epidemic Circa (3000 B.C), plague, Spanish flue (nearly a century ago, which caused for millions of deaths), to present COVID 19. The man survived all these relentless onslaughts from time to time with the grit and determination and unstinted efforts of the scientific community for the development of antibiotics, antiviral and other drugs and vaccines.

*It may be an exaggeration, but I feel...*

At this moment, most of us, if not all are adversely affected in one or more aspects like physical, physiological, psychological and economic. Of course, this is my reference to the COVID-19 pandemic situation. The human race is in a transition state and requires the transformation from pandemic to post pandemic situation. The period of transformation may not be same for all situations but certainly unpredictable. By gazing the present situation, it looks we require more time than initially anticipated for normalcy (normality). Again, it depends on the development and availability of vaccine to the larger proportion of the population.

We assume work pressure will cause stress; but even sitting idle will also result the same. Stress and undue worrying lead to emotional problems of an individual.

**Therefore "Better to be busier in productive work than to be busy worrying."**

## **Medicine Watch**

### **Tapentadol hydrochloride: A novel Opioid analgesic**

*Dr. K. Sunil Kumar, M.Pharm, Ph. D, Professor, Dep. of Pharmacology.*

*V. Gayathri, B. Pharmacy*

Tapentadol is a novel centrally acting opioid analgesic with a dual mode of action as an agonist of the  $\mu$ -opioid receptor and as a norepinephrine reuptake inhibitor (NRI). It is similar to Tramadol in its dual mechanism of action, namely its ability to activate the  $\mu$  opioid receptor and inhibit the reuptake of norepinephrine. Analgesia occurs within 32 minutes of oral administration and lasts for 4–6 hours. Unlike tramadol, it has only weak effects on the reuptake of serotonin and is a significantly more potent opioid with no known active metabolites.

Tapentadol is not a pro-drug and therefore does not rely on metabolism to produce its therapeutic effects. This makes it a useful moderate-potency analgesic option for patients who do not respond adequately to more commonly used opioids due to genetic disposition (poor metabolizers of CYP3A4 and CYP2D6), as well as providing a more consistent dosage-response range among the patient population. It is generally regarded as a weak-moderate strength opioid (a category shared by any better known opioids such as Hydrocodone and Pethidine). Tapentadol was approved by the US FDA in November 2008, by the TGA of Australia in December 2010 and by the MHRA of the UK in February 2011 and by FDC in India in January 2019.

#### **INDICATION**

Tapentadol is used for the treatment of moderate to severe pain for both acute (following injury, surgery, etc) and chronic musculoskeletal pain. It is also specifically indicated for controlling the pain of diabetic neuropathy when around-the-clock Opioid medication is required. Extended-release formulations are not indicated for use in the management of acute pain. It is 18 times less potent than morphine in terms of binding to human  $\mu$ -opioid receptors

found in in-vitro research on human tissue. In in-vivo, only 32% of an oral dose of it will survive first pass metabolism and proceed to the bloodstream to produce its effects on the central and peripheral nervous systems of the patient. It has much weaker effects on the reuptake of serotonin and is a significantly more potent opioid with no known active metabolites.

#### **DOSING**

Initial dose: 50 to 100 mg orally every 4 to 6 hours as needed for pain. A second dose may be administered as soon as 1 hour after the first dose if needed. Subsequent dosing: 50, 75, or 100 mg orally every 4 to 6 hours, adjust dosing to maintain adequate analgesia with acceptable tolerability. Maximum dose: 700 mg on day 1, 600 mg/day on subsequent days. Tapentadol may be administered orally with or without food.

#### **SIDE EFFECTS**

The most commonly reported side effects of Tapentadol therapy in clinical trials were nausea, vomiting, dizziness, sleepiness, itchiness, dry mouth, headache, and fatigue. According to the World Health Organization there is little evidence to judge the abuse potential of Tapentadol.

#### **CONTRA-INDICATIONS**

- Used cautiously in patients with a history of seizures.
- Patients using other serotogenic and adrenergic medications.
- Patients with head trauma, metabolic disorders, and those in alcohol and/or drug withdrawals.
- It has been demonstrated to potentially produce hypotension.
- Not recommended for use in women during and immediately prior to labor and delivery.
- There are no adequate and well-controlled studies of Tapentadol in children.

# Student's corner

## Bioprinting: is this the future of organ transplantation?

Kudapa Navya Sai, Pharm. D VI Year

Bioprinting is a 3D fabrication technology used to precisely dispense cell-laden biomaterials for the construction of complex 3D functional living tissues or artificial organs.

The first step of bioprinting is to create a model of the organ using biopsy samples, CT scan, and MRI. Then, a mixture of cell and nutrients also called as bio ink are added to the scaffold in a layer-by-layer approach to generate tissue-like structures.

Bioprinters work in *almost* the exact same way as 3D printers, with one key difference. Instead of delivering materials such as plastic, ceramic, metal or food, they deposit layers of biomaterial that may include living cells, to build complex structures like blood vessels or skin tissue. There are many different printers in the market and undergoing testing, and therefore methods for delivering these cells and biomaterials also differ. Some of the more commonly used methods include extrusion, laser, microvalves, inkjet and tissue fragment printing.

### BIOPRINTING PIONEERS

Several experimental bioprinters have already been built. In 2002, Professor Makoto Nakamura realized that the droplets of ink in a standard inkjet printer are about the same size as human cells. He therefore decided to adapt the technology, and by 2008 he had created a working bioprinters that can print out bio tubing similar to a blood vessel.

Another bioprinting pioneer is Organovo. Since 2008, Organovo has worked with a company, Invetech to create a commercial bioprinter called the NovoGen MMX. This is loaded with bioink spheroids that each contain

an aggregate of tens of thousands of cells. To create its output, the NovoGen first lays down a single layer of water based bio paper made from collagen, gelatin or other hydrogels. Bio ink spheroids are then injected into this water-based material. As illustrated below, more layers are subsequently added to build up the final object. Amazingly, Nature then takes over and the bio ink spheroids slowly fuse together. As this occurs, the bio paper dissolves away or is otherwise removed, thereby leaving a final bio printed body part or tissue.

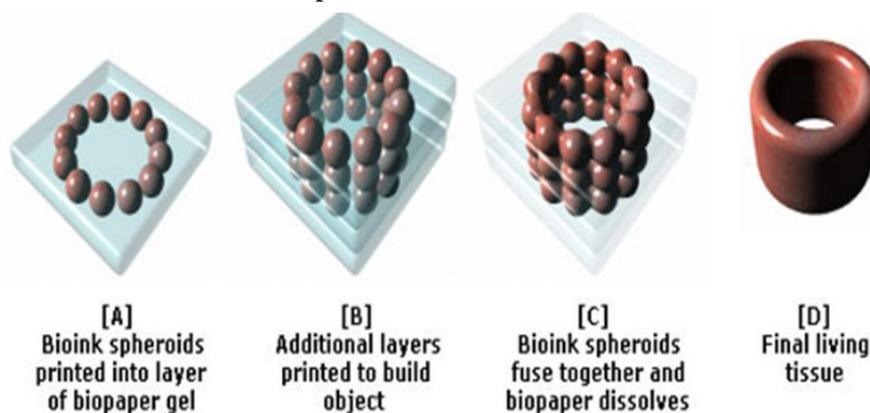
For example, experimental blood vessels have been bio printed using muscle and fibroblast cells. Once placed in

the right places, appropriate cell types somehow just know what to do.

### APPLICATIONS OF BIOPRINTING

**BONE:** Researchers' bio print an exact copy of the part of a bone which they are trying to replace this becomes the scaffold and this process takes around 2 hours. The final product is then implanted into the body, where, within about three months, the scaffold will disappear and be replaced by new bone.

**SKIN:** If a person is badly burned, healthy skin can be taken from an-



position by the bio print head, and with no technological intervention, the endothelial cells migrate to the inside of the bio printed blood vessel, the smooth muscle cells move to the middle and the fibroblasts migrate to the outside. In more complex bio printed materials, intricate capillaries and other internal structures also naturally form after printing has taken place. The process may sound almost magical. However, as Professor Forgacs explains, it is no different to the cells in an embryo knowing how to configure in to complicated organs. Nature has been evolving this amazing capab-

ility for millions of years. Once in the right places, appropriate cell types somehow just know what to do. other part of the body and used to cover the affected area. A scanner first determines the size and depth of the wound, and this information is passed to the printer, while this technology is still in the experimental stage, researchers hope it will be widely available within the next five years.

**BLOOD VESSELS:** Using an agarose fiber template covered with hydrogel, researchers were able to construct microchannel networks which exhibited various architectural features.

# Student's corner



**INTERNAL ORGANS:** Less complex organs such as bladders are already possible. Researchers have successfully taken cells from a patient's original, poorly functioning bladder, cultivated them and added additional nutrients. A 3D mould of the patient's bladder was then printed and the cultivated cells soaked through it. The mould was placed in an incubator a bit like baking a cake and when it came out, was able to be transplanted into the patient's body. The mould will eventually break down, leaving only the organic material behind. They have also successfully produced viable **urethras**. Once again, a combination of a patient's own cells and additional nutrients is seeded with scaffolding and then sewn into the correct shape of a urethra. These engineered parts can then be transplanted back into the patient's body.

While bioengineers have successfully printed a tiny (1 millimeter thick x 4 millimeters wide) 3D functioning **liver**, it survived for only five days. It's a start, but there's a long way to go.

**Kidneys** are also incredibly difficult as they contain complex cellular pro-

cesses for filtration not something that can be easily replicated. Researchers have used human stem cells to grow a kidney organoid that contains all the required cell types for a kidney. Amazingly, **hearts** may be one of the easier organs to make, as they're essentially a pump with tubes. Of course, it's not quite as simple as that, but many researchers believe that we'll have transplantable bio hearts before kidneys or livers.

While it's easy to print a full replica of an organ, it's more difficult to make it 'real', with blood vessels, connecting tissues, nerves, filtration systems, strength, durability and all the aspects that go in to making our 'natural' organs so complex. These challenges aren't putting off the many researchers who are working to find solutions to these intricate problems.



**HUMAN CARTILAGE:** A biopsy is performed on the patient and cartilage cells removed from his or her own body, for example from the knee, finger, ear or splinters of the shattered nose. The cells are spawned in the laboratory and mixed with a biopolymer. From this toothpaste-like suspension, a nose cartilage transplant is created using the bioprinter, which is implanted in the patient during surgery. to print a full-sized human nose implant it takes under 20 minutes.

**BONUS USE:** One of the most exciting recent advances is the idea of a

'benchtop brain'. They have developed a 3D printed, six-layered structure that incorporates neural cells that mimic the structure of brain tissue.

This has huge potential benefits for researchers, pharmaceutical companies and private companies. It will enable them to test new products and drugs on tissue that accurately reflects human brain tissue, as opposed to animal specimens which can produce a very different reaction. The benchtop brain could also be used to further research into brain disorders such as schizophrenia or Alzheimer's disease.

**BIOPEN:** The Bio Pen allows surgeons to draw bio-ink directly onto damaged bone or cartilage to repair damage.



## ADVANTAGES

Bioprinting could replace organ donors, Bioprinting could prevent cell rejection, Bioprinting could replace animals in testing labs, Bioprinting can replace volunteers in drug testing labs.

## DISADVANTAGES

High Energy Consumption, 3D Printing Technology is Expensive, Limited Materials, 3D Printers Aren't that User-friendly, Harmful Emissions, Too Much Reliance on Plastic, 3D Printers are Slow, Production of Dangerous Weaponry, Copyright Infringements, Manufacturing Job Losses.

# Indigenous Space

## APPLE BER; MULTIPLE HEALTH BENEFITS OF COMMON MAN APPLE

Ms. D. Vidhyakini, M. Pharm, Asst. Professor, Dep. of Pharmacognosy

Samson P, B. Pharmacy

**Apple Ber** (*Ziziphus mauritiana*) is a Thailand variety fruit. It is the imported crossbreed of green apple and jujube. It is also known as the Indian jujube or Chinese date or Apple Plum or Apple Berry.

### DESCRIPTION

This plant starts giving fruits after 6-8 months of plantation. Generally the height of the plant would be between 10-15ft. About 450 to 500 plants can be accommodated in an acre. Plums are mainly produced during December to January. This tree gives 25-30kg and 45-50 kg fruits during first and second years respectively. Hyderabad is one of the famous markets for Apple Ber.

### TRADITIONAL USES

The fruit has been used in traditional medicine as:

- ◆ An emollient, expectorant, coolant, anodyne and tonic.
- ◆ An antidote for aconite poisoning.
- ◆ To relieve abdominal pains during pregnancy.
- ◆ Can be applied to wounds when used in a poultice.
- ◆ The leaves can be used as a laxative and for throat problems as a decoction and for skin problems.
- ◆ The roots have wound healing properties too.

### CURRENT RESEARCH

Medical researchers have found a “new” flavonoid in Ber called **zivulgarin** and trials are underway to discover how it might benefit us. **Oleamide** found in an extract has been found to help fight Alzheimer’s disease and help the cognitive processes.

It has been found that there are **saponins** in the leaves and vitamin C in the form of ascorbic acid in the fruit, as well as the B-complex vitamins, thiamin, riboflavin and pectin. It has immune stimulant, antioxidant and pectin is known to be useful in cases of diarrhea. The fruit also helps lower cholesterol levels and blood pressure. Some of the triterpenoid ac-

ids isolated from the fruit are also believed to be useful in fighting cancer and HIV. They are also known to contain 18 of the 24 essential amino acids that the body needs.

### HEALTH BENEFITS

#### 1. Anti-cancer properties:

Recent experiments proved that it was especially effective in preventing leukemia, the most violent form of cancer.

#### 2. Sedative properties:

It helps in treating anxiety and insomnia and also more serious disorders like psychosis and epilepsy.

#### 3. Strengthens the immune system:

The high amounts of Vitamin C and Vitamin A that are present in these fruits make it a great antioxidant which also helps boost the immune system activities of the body.

#### 4. Keeps teeth, bones and muscles healthy:

It is rich in calcium, the basic mineral that constitutes the teeth, bones and muscles. Making these fruits part of our regular diet helps us strengthen the bones, muscles and teeth.

#### 5. Keeps skin healthy and young:

Vitamin C helps slow ageing process because of the antioxidants that are present in it.

#### 6. Aids in weight loss:

They have no carbohydrates or fats and are abundant in fiber.

#### 7. Aids digestion:

Apple Ber fruit is known to aid with digestion and absorption. It is especially helpful for people who have been suffering from digestive problems, constipation and flatulence.

#### 8. Soothes sore throat:

Fruit extracts are used to soothe the pain and ache that comes with sore throat. When combined with ginger or mint and consumed in the form of a potion, the fruit juice soothes the throat.

#### 9. Fights Alzheimer:

Recent experiments have indicated that it can help to fight Alzheimer by helping fight cell degeneration and aiding in cognitive functioning of the brain.



# Faculty achievements

Our faculty had delivered talks on various topics in online webinars organized by different Colleges / Universities across the globe.

FACULTY DETAILS	DELIVERED TALK ON	WEBINAR ORGANIZED BY	CONDUCTED ON
 <p><b>Dr. Nalini Kanta Sahoo</b> Professor &amp; HOD, Department of PA &amp; QA</p>	<i>India's dominance in combating emerging health challenges through discovery of therapeutic armamentarium.</i>	<b>Sandip University</b> , Pune in collaboration with Indian Pharma Educational Society, Lucknow	15 <sup>th</sup> & 16 <sup>th</sup> May, 2020
	<i>Metabolomics approaches for the development of newer biomarkers using bioinformatics tools</i>	<b>Sarat Chandra Pawar College of Pharmacy</b> , Pune	4th June 2020.
	<i>Developemet of newer biomarkers and early prognosis of drug induced hepatotoxicity through NMR based metabolomics approaches.</i>	<b>Conference series LLp.</b> , London, United Kingdom.	18 <sup>th</sup> & 19 <sup>th</sup> june,2020
	<i>Pharmacovigilance- A new Era and its impact on Society</i>	<b>Aditya Bangalore Institute of Pharmacy, Education &amp; Research and Indian Pharmaceutical Association (I.P.A)</b>	04th July 2020.
	<i>Role of LC-MS in biomarker development</i>	<b>Sagar Institute of Research &amp; Technology-Pharmacy (SIRT-P)</b> , SAGE University, Bhopal	17th July 2020.
 <p><b>Dr. Arunabha Mallik</b> Professor &amp; HOD, Department of Pharmacology</p>	<i>Online National Conference on "Covid-19 Challenges and Oppor- tunities For Pharmaceutical In- dustry"</i>	<b>Bansal College Of Pharmacy</b> , Bhopal, M.P	11th May 2020
	<i>SAGETALKS on "Animal use in Pharmacology Education and Re- search- The Changing Scenario"</i>	<b>Sagar Institute of Research &amp; Technology - Pharmacy</b> , Bhopal, M.P	5th June 2020
 <p><b>Dr. Sunil Kumar. K</b> Associate Professor, Department of Pharmacology</p>	<i>"Mental Health and Social stigma associated with COVID-19 Pan- demic"</i>	<b>Santhiram College of Pharmacy</b> , Nandyala, Kurnool (dt).	27th June 2020
	<i>"Human values and ethics in Pharmacy Profession"</i>	<b>Datta Meghe Institute of Pharmacy</b> , Salod (H), Wardha, Maharashtra	14th July 2020.

## Health days to remember

# Important Health Days

September - December 2020

### SEPTEMBER

Childhood Cancer Awareness Month  
 Sept 10 - World Suicide Prevention Day  
 Sept 13 - World Sepsis Day  
 Sept 15 - World Lymphoma Awareness Day  
 Sept 17 - World Patient Safety Day  
 Sept 21 - World Alzheimer's Day  
 Sept 22 - Falls Prevention Day  
 Sept 26 - World Contraception Day  
 Sept 28 - World Rabies Day  
 Sept 29 - World Heart Day

### OCTOBER

(Oct 4-10) Mental Illness Awareness Week  
 Oct 04 - World Dyslexia Awareness Day  
 (Oct 5-9) Malnutrition Awareness Week  
 Oct 6 - World Cerebral Palsy Day  
 Oct 10 - World Mental Health Day  
 (Oct 16-22) International Infection Prevention Week  
 Oct 16 - World Food Day  
 Oct 19 - World Pediatric Bone and Joint Day  
 Oct 20 - World Osteoporosis Day  
 Oct 20 - International Stuttering Awareness Day  
 Oct 29 - World Psoriasis Day

### NOVEMBER

(Nov 11-17) World Antibiotic Awareness Week  
 Nov 14 - World Diabetes Day  
 Nov 17 - World Prematurity Day  
 Nov 19 - International Men's Day  
 Nov 21 - International Survivors of Suicide Day

### DECEMBER

Dec 1 - World AIDS Day  
 Dec 3 - International Day of Persons with Disabilities



*Dr. Kainat Panjwani, Pharm. D, Asst. Professor, Dep. of Pharmacy Practice*

## 58<sup>th</sup> National Pharmacy Week celebrations

The Department of Pharmacy Practice, Marri Laxman Reddy Institute of Pharmacy, Dundigal, Hyderabad, Telangana State had celebrated the 58<sup>th</sup> National Pharmacy Week which was witnessed an enthusiastic participation of students and staff. The celebrations include medical awareness programs for nearby school and college students, medical camp and inspirational speeches by eminent speakers.

On Day 1, our celebrations were started with health awareness sessions by students of Doctor of Pharmacy (Pharm. D) to the 9<sup>th</sup> & 10<sup>th</sup> class school children of **CMR International School, Shapur Nagar and Sri Sloka School of Excellence, Gandimaisamma in Hyderabad** on “**Prevalence of Anaemia And Its Prevention by Following Proper Diet Plan In Girl Children**” (exclusively for girl students) and “**Types of Seizures and its First-Aid Techniques**”.



**DAY 1: AWARENESS PROGRAMME  
(FORENOON SESSION)**

**DAY 1: AWARENESS PROGRAMME  
(AFTERNOON SESSION)**



**DAY 2: FREE MEDICAL CAMP (MORNING SESSION)**

On Day 2, in the morning session, a free medical camp was organized in association with **Maxivision Super Speciality Eye Hospitals and Clove Dental Hospital** to the school students of Zilla Parishad High School, Dundigal and also to the students of Marri Laxman Reddy Institute of Technology, Management & Pharmacy. The camp was inaugurated by **Dr. K. S. Murali Krishna, Principal, MLRIP**. In this medical camp, around 300 school and college students had undergone free Dental and Eye check-up by doctors from these hospitals and medicines were prescribed.



DAY 2: GUEST LECTURE  
(POST-LUNCH SESSION)

DAY 3: GUEST LECTURE

True to the theme of 58<sup>th</sup> National Pharmacy Week - **“Pharmacist: Your Medication Counsellor”**, students of Doctor of Pharmacy (Pharm. D) have counselled the school students.

On Day 2, during Post-Lunch session, **Dr. Hafsa Basheer Ahmed, B.D.S**, Dental Surgeon, from Clove Dental Hospital, had delivered a guest lecture on **“Dental Hygiene and Awareness”** to the students of B. Pharm & Pharm. D.

On Day 3, **Mr. Nisar Ahamed, M. Pharm, former Senior Pharmacist, Johns Hopkins Aramco Healthcare, Dhahran, Saudi Arabia**, has enlightened the prospective of Pharm. D course and the role and responsibilities of Clinical Pharmacist in a health care team for providing a better health to the patient.

The celebrations were aptly concluded on day 4, with similar health awareness programmes (like on day 1) for 10<sup>th</sup> class & intermediate students of **NSKK (Naveena Samskarika Kala Kendram) High School & Junior College, Gagillapur** in the forenoon session and 10<sup>th</sup> class students of **Zilla Parishad High School, Dundigal** in the after-noon session.



DAY 4: AWARENESS PROGRAMME  
(FORENOON SESSION)



DAY 4: AWARENESS PROGRAMME  
(AFTERNOON SESSION)

All the events were monitored by the staff of the Department of Pharmacy Practice.

**This event was reported in**

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# Pharma Times

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**APTI BULLETIN**

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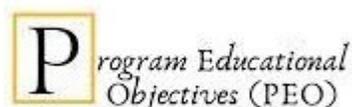
# About MLRIP



To be an educational institute of par excellence and produce competent pharmacy professionals to serve the community through research and the ever-increasing needs of Industry.



1. Imparting quality education and innovative research for various career opportunities.
2. Creating conducive academic environment to produce competent pharmacy professionals.
3. Indoctrination of students adorned with high human values and make them aware of their responsibility as health care professionals.

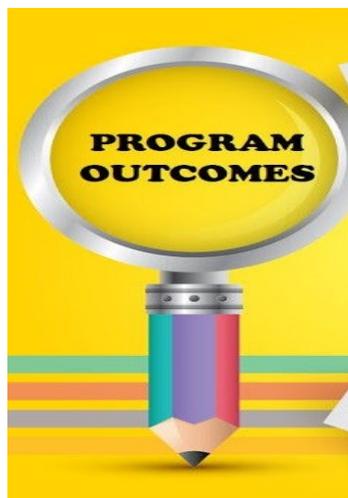


**PEO 1:** To produce graduates with sound theoretical knowledge and technical skills required for their career opportunities in various domains.

**PEO 2:** To incite the students towards research and to address the challenges with their innovative contributions for the benefit of the mankind.

**PEO 3:** To instill the essence of professionalism, ethical commitment to become a health care professional with sound integrity and adherence to the core human values in the service of the society.

1. **Pharmacy Knowledge:** Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.



2. **Planning Abilities:** Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

3. **Problem analysis:** Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

4. **Modern tool usage:** Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

5. **Leadership skills:** Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well-being.

6. **Professional Identity:** Understand, analyze and communicate the value of their professional roles in society (e.g., health care professionals, promoters of health, educators, managers, employers, employees).

7. **Pharmaceutical Ethics:** Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

8. **Communication:** Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

9. **The Pharmacist and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

10. **Environment and sustainability:** Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

11. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.