Department: Mathematical Sciences

3.3.2 Workshops/ Seminars conducted on Research Methodology, Intellectual Property Rights, entrepreneurship, skill development

Documents Attached

- Report of the event
- Brochure /Photograph of the event
- Details of Resource Persons

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Report of the event

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Teacher's Enrichment Workshop on Numerical Methods for Solving Differential Equations

IKG Punjab Technical University Jalandhar
Dec 25 to 30, 2019

Academic Report

Participants:

The Teacher's Enrichment Workshop (TEW) concluded successfully on Dec 30, 2019 in the Department of Mathematical Sciences, IKG Punjab Technical University Jalandhar. The following 40 participants (37 teachers and 03 Research Scholars*) attended this Workshop.

*These three research scholars were allowed to attend this workshop, but the certificates were distributed to the Teachers only

1	Techers				
Sr	SID	Full Name	Gender	Email ID	Name of college/University where employed/studying
1	29373	Dr. Kulwinder Singh Parmar	M	kulmaths@gmail.com	I K Gujral Punjab Technical University
2	30193	Mr. Prince Singh	M	princesingh16092@gmail.com	Lovely Professional University
3	30482	Dr. Sarika Verma	F	sarika.1698@gmail.com	DAV University, Jalandhar
4	31108	Dr. Rajesh Kumar Narula	M	dr.rknarula@gmail.com	IKG PTU Jalandhar
5	31160	Dr. Rajni Sharma	F	rajni_daviet@yahoo.com	DAVIET, Jalandhar
6	31161	Mrs. Neeru Sharma	F	neeru.daviet@gmail.com	DAVIET, Jalandhar
7	31164	Mr. Rajat Singla	M	rajatsingla1310@gmail.com	Akal University
8	31175	Dr. Dilbaj Singh	M	Dilbaj2105@gmail.com	Lyallpur Khalsa College of Engineering
9	31182	Dr. M. S. Barak	M	ms_barak@igu.ac.in	Indira Gandhi University, Meerpur Rewari

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10	31186	Dr. Harpreet Kaur	F	manih37@gmail.com	IKG PTU Jalandhar
11	31201	Ms. Harmandeep Kaur	F	harmandeep.hk1994@gmail.com	IKGPTU Amritsar Campus
12	31216	Mr Amandeep Singh	M	asinghrana@gmail.com	PTU Campus
13	30002	Ms Rajbir Kaur	F	jassalwalia@gmail.com	DAV College, Amritsar
14	29361	Dr. Vikramjeet Singh	M	vikram11782@gmail.com	IKGPTU Campus Batala
15	31148	Dr. Vijayata Pathania	F	vijayatapathania@yahoo.com	Himachal Pradesh University, Regional Centre
16	31153	Dr. Shweta Pathania	F	shwetanithar@gmail.com	College of Basic Sciences, CSK Himachal Pradesh Agricultural University
17	31231	Ms. Rajbir Kaur	F	rajbirannar@yahoo.com	Guru Nanak Dev Engineering College
18	31158	Mr. Ratesh Kumar	M	ratesh.11755@lpu.co.in	Lovely Professional University
19	31168	Dr. Shiv Kumar Tuli	M	abhitul60@gmail.com	DAV College, Jalandhar
20	31251	Prof. Sidhu Jitendra Singh Makkhan	M	sidhujatinder78@gmail.com	SGAD College Khadoor sahib
21	31246	Mr. Mohd. Anwer	M	anwermath12@gmail.com	Govt. Girls Sr. Sec. School
22	30654	Mr. Pankaj Kumar	M	pankaj.kumar1@lpu.co.in	Lovely Professional University
23	30730	Mr. Gurpreet Singh Bhatia	M	gurpreetsidakbhatia@gmail.com	Lovely Professional University
24	30740	Dr. Kulwinder Singh	M	kulwinder.11033@lpu.co.in	Lovely Professional University
25	30783	Dr. Sukhdev Singh	M	singh.sukhdev01@gmail.com	Lovely Professional University
26	31178	Prof. Sanjeev Kumar	M	kumar200sanjeev@gmail.com	Govt. College Dhaliara
27	31233	Mr. Vinay Arora	M	vinay2037@gmail.com	Punjab University SSG Regional College
28	31222	Dr. Rajpreet Kaur	F	dr.rajpreet@ptu.ac.in	IKGPTU, Jalandhar

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29	31139	Dr. Sachin Kaushal	M	sachin_kuk@yahoo.co.in	Lovely Professional University
30	30728	Dr. Seema	F	seemamaths5@gmail.com	Chandigarh University, Mohali
31	31144	Mrs. Shikha Jolka	F	shikha.tandon@gmail.com	IKGPTU, Jalandhar
32	31227	Dr. Naveen Kumar Sharma	M	naveen11.sharma@gmail.com	Panjab Technical University, Jalandhar
33	31212	Dr. Manish Gupta	M	manish.gupta@bbsbec.ac.in	BBSB Eng. College, Fatehgarh Sahib
34	31214	Dr. Neetika	F	neetikaphy@ptu.ac.in	PTU, Jalandhar
35	31209	Dr. Amit Bansal	M	amit.bansal978@gmail.com	Punjab Technical University, Jalandhar
36	31236	Dr. Varun Jain	M	varun82jain@gmail.com	M.M. Modi College, Patiala
37	31230	Dr. Deepak K. Goyal	M	dr.deepakgoyal@ptu.ac.in	IKGPTU, Jalandhar

II.	Research Scholars				
Sr.	SNID	Full Name	Gender	Email	Name of college/University where studying
1	-	Pooja Maurya	F	priyankaguptamanikpur@gmail.com	MGCG Vishwavidyalya, Chitrakoot, MP
2	-	Priyanka Gupta	F	maurya.pooja2011@gmail.com	MGCG Vishwavidyalya, Chitrakoot, MP
3	30790	Akash Kumar	M	akashkumarsidana@gmail.com	Punjab University, Chandigarh

Speakers:

Details of Resource Persons

1. Dr Thirupathi Gudi, IISC, Bangalore.
2. Dr Mani Mehra, IIT Delhi.
3. Dr Rama Bhargava, IIT Roorkee.

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4. Dr Jitender Singh, GNDU, Amritsar.
5. Dr. Suraj Goyal, DAV University, Jalandhar
6. Dr. Gurjinder Singh, IKGPTU Jalandhar
7. Dr. S.K. Tomar, Punjab University, Chandigarh
8. Dr. Vinay Kanwar, Punjab University, Chandigarh

Tutors:

1. Dr. Mani Mehra, IIT Delhi
2. Dr. Thirupathi Gudi, IISc Bangalore
3. Dr. Suraj Goyal, DAV University, Jalandhar
4. Dr. Gurjinder Singh, IKGPTU Jalandhar

Details of Actual Syllabus Covered:

I. Lectures by Dr. Thirupathi Gudi (Dec 25-27, 2019)

In his five lectures of one hour each and one tutorial session from Dec 25-27, 2019, the following topics on Finite Element Method (FEM) and Its Application were covered:

In the first lecture, Dr. Gudi discussed the idea of FEM by considering 1-D problems. Then he established the theoretical basis of FEM from a rigorous point of view.
Second lecture was concerned with development of FEM for solving 2-D problems. He thoroughly explained the different types of finite elements and basis functions used in finite element analysis of partial differential equations (PDEs). The idea was further elaborated by discussing different approaches of FEM.

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Third, fourth and fifth lectures and tutorial were conducted in Numerical Simulation Lab, where he discussed how to develop MATLAB codes of FEM for solving 1-D and 2-D problems. He also explained the adaptive FEM MATLAB coding. Dr. Gudi explained very clearly each line of FEM codes and implemented them in the Lab. He also guided each participant to develop their own MATLAB code of FEM and run it on the computer.

II. Lectures by Dr. Mani Mehra (Dec 25, 2019)

In her three lectures of one hour each and one tutorial sessions on Dec. 25, 2019, the following topics in Initial Value Problems (IVPs) in Ordinary Differential Equations (ODEs) were covered:
In the first lecture, Dr. Mani Mehra introduced the idea of numerical approximation of true solution of a given IVP in ODE. She discussed this idea by considering a simplest method of Euler and prepared a ground for theoretical discussion of existing conventional numerical integrators.
Second lecture was concerned with conventional classes of numerical integrators, for instance Runge-Kutta type methods and Linear multistep methods. She also discussed the different implementation modes of these methods in order to solve a given problem.
In the third lecture, Dr. Mani Mehra discussed three basic concepts: consistency, stability and convergence of numerical methods. These concepts were explained very clearly by giving suitable examples.
In the tutorial hour, she addressed the questions of participants and guided them to recall all the topics covered in the lectures and motivated them for further study.

III. Lectures by Dr. Rama Bhargava (Dec. 26, 2019):

In her two lectures of one hour each on Dec. 26, 2019, the following topics in Finite Element Methods were covered:
In the first lecture, Dr. Rama Bhargava discussed the need of finite element analysis of differential equations in various fields of applications. Many physical phenomena were discussed to illustrate the effectiveness of FEM.
In the second lecture, different types of differential equations were analyzed by FEM.

IV. *Lectures by Dr. Jitender Singh (Dec 27-28, 2019)*

In his four lectures of one hour each from Dec. 27-28, 2019, the following topics in Differential Equations were covered:

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In the first lecture, Dr. Jitender Singh introduced the idea of numerical approximation of boundary value problems (BVPs) in ordinary differential equations using shooting approach. Further, he elaborated the idea by considering different types of BVPs.
Second, third and fourth lectures were delivered in the Numerical Simulation Lab. In the lab, first he discussed how to develop MATLAB code of Runge-Kutta type methods for solving system of IVPs in ODEs. Then he discussed the MATLAB coding of shooting method and implemented on different problems in the Lab.

He addressed the questions of participants and guided them to develop their own MATLAB codes of linear and nonlinear shooting method for BVPs.

V. **Lectures by Dr. Gurjinder Singh (Dec 28, 2019)**
In his one lecture of one hour on Dec. 28, 2019, the following topics concerning numerical approximation of IVPs in ODEs were covered:
He discussed the development of Linear multi-step methods by computer algebra system. In the numerical simulation Lab, he discussed how to develop MATLAB codes of numerical methods for solving IVPs in ODEs. Further, he implemented the Runge-Kutta type and linear multi-step methods in MATLAB. He elaborated the importance of high accuracy methods compared with low accuracy methods by implementing them in MATLAB.
He addressed the queries of participants and guided them to develop and implement their own MATLAB codes for numerical methods.

VI. **Lectures by Dr. Suraj Goyal (Dec 28, 2019)**
In his one lecture of one hour on Dec. 28, 2019, the following topics in MATLAB were covered:
Dr. Suraj Goyal introduced the computer algebra system (CAS) MATLAB and its different uses. He discussed a good collection of built-in functions available in MATLAB by implementing them.
Firstly, different types of loops and conditional structures were introduced. Then, MATLAB codes of different methods through script files and function files were developed and implemented in the Numerical Simulation Lab. He also discussed the idea of MATLAB programming for solving simple ordinary differential equations using numerical techniques.
He addressed the questions of participants and guided them in the use of MATLAB for handling different tasks in the Lab.

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VII. Lectures by Prof. S.K. Tomar (Dec 29-30, 2019)

In his four lectures of one hour each from Dec. 29-30, 2019, the following topics in Boundary Value Problems were covered:

In the first lecture, Dr. Tomar discussed the idea of finite differences used in numerical approximation of true solutions of differential equations. He also discussed advantages and disadvantages of this approach. He first introduced the conventional forward, backward and central finite difference approximations to derivatives and their accuracy also. He derived the different finite difference approximations to derivatives with the use of Taylor series.

In the second lecture, he discussed the development and implementation of finite difference methods (FDMs) for solving boundary value problems in ordinary differential equations. Then he addressed the theoretical questions concerning order of accuracy, consistency and stability of FDMs.

Third lecture was concerned with development and implementation of FDMs for solving PDEs. He considered different types of PDEs and developed different types of FDMs. The question concerning development of new FDMs was also addressed. He focused on theoretical and computational aspects of order of accuracy, consistency and stability of FDMs for solving PDEs.

In the tutorial hour, he answered the queries of participants and guided them for further study on FDMs.

VIII. Lectures by Prof. Vinay Kanwar (Dec 29-30, 2019)

In his four lectures of one hour each from Dec. 29-30, 2019, the following topics concerning Initial Value Problems in Ordinary Differential Equations were covered.

In the lectures, he discussed the development of Runge-Kutta type and linear multistep methods using different approaches for example Taylor series, interpolation and collocation and numerical quadrature etc. Then he discussed the significance of consistency, zero-stability, linear stability and convergence of numerical integrators for solving IVPs in ODEs from a theoretical point of view. He also explained the computational and theoretical order of accuracy of a method.

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He implemented one-step and multi-step methods in different implementation modes in order to solve IVPs having different characteristics. Further, he illustrated the significance of implementation mode of a numerical method. The main focus of the lectures was on development, analysis and implementation using computer algebra system of numerical integrators.

Time Table followed:

Day	Date	Lecture 1 (9.30–10.30)	Tea (10.35-10.55)	Lecturer 2 (11.00–12.00)	Lecture 3 (12.00–1.00)	Lunch (1.00 – 2.20)	Lecture 4 (2.30-3.30)	Tea (3.35 - 3.55)	Discussion (4.00-500)
		(Speaker's name)		(Speaker's name)	(Speaker's name)		(Speaker's name)		(Tutor's name)
Wed	Dec 25	Thirupathi Gudi		Mani Mehra	Mani Mehra		Mani Mehra		Mani Mehra
Thu	Dec 26	Thirupathi Gudi		Rama Bhargava	Rama Bhargava		Thirupathi Gudi		Thirupathi Gudi
Fri	Dec 27	Thirupathi Gudi		Thirupathi Gudi	Jatinder Singh		Jatinder Singh		Gurjinder Suraj
Sat	Dec28	Jatinder Singh		Jatinder Singh	Gurjinder Singh		Suraj Goyal		Gurjinder Suraj
Sun	Dec29	SK Tomar		SK Tomar	Vinay Kanwar		Vinay Kanwar		Gurjinder Suraj
Mon	Dec30	Vinay Kanwar		Vinay Kanwar	SK Tomar		SK Tomar		Gurjinder Suraj

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ਪ੍ਰੋ. (ਡਾ) ਅਜੈ ਕੁਮਾਰ ਸ਼ਰਮਾ
ਉਪ-ਕੁਲਪਤੀ
Prof. (Dr) Ajay K Sharma
Vice Chancellor
Ph D, LMISTE, LMOSA, LACSI, LMSPIE, FIETE
Former Director NIT Delhi, NIT Hamirpur,
Mentor Director IIIT, Una

ਆਈ.ਕੇ.ਗੁਜਰਾਲ ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ
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No. :IKGPTU/Acad/

Dated : 04/01/2020

I appreciate the efforts made by Dr. Megha Goyal, Assistant Professor, Department of Mathematical Sciences, I. K. Gujral Punjab Technical University for organized a National Level 'Teacher Enrichment Workshop (TEW)' on Computational Methods for Solving Differential Equations in collaboration with National Centre for Mathematics (NCM), a joint venture of IIT Bombay and TIFR, from 25.12.2019 to 30.12.2019.

I hope the department of Mathematical Sciences shall organize such academic programs from time to time for the benefit of teachers, research fellows and for the progress of the department. I wish her all the best.

04/01/2020
(Dr. Ajay K Sharma)

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Photograph of the event

Photo of Participants in Teacher Enrichment workshop on Computational Methods for Solving Differential Equations (25-12-2019 to 30-12-2019)