

**3.4.3 Details of research papers per teacher in CARE Journals notified on UGC website during the year**

Name of the Author(s)	Department of the Author(s)	Title of the Paper	Name of the Journal	Month and Year of publication	ISSN	Link to the notification in UGC enlistment of the Journal
Nihar Pednekar, Satyajit Patil	Automobile Engineering	Component Sizing of Electric Vehicles: A Programming Approach	SAE Technical Papers	06-10-2022	0148-7191	<a href="https://www.scopus.com/sourceid/21100239259">https://www.scopus.com/sourceid/21100239259</a>
Satyajit R. Patil, Sushma S. Kulkarni	Automobile Engineering	NAAC Student Satisfaction Survey: A Reliable and Effective Instrument for Institutional Quality Assurance	Journal of Engineering Education Transformations (JEET)	Jan-23	2394-1707	<a href="https://www.scopus.com/sourceid/21100890669">https://www.scopus.com/sourceid/21100890669</a>
Sumit S. Naygaonkar, Sandeep R. Desai	Automobile Engineering	Design and Numerical Investigation for Reduction of Hand-Arm Vibrations from Steering Wheel of an Agricultural Tractor	International Journal of Vehicle Noise and Vibration	16-09-2022	1479-1471	<a href="https://www.scopus.com/sourceid/7500153107">https://www.scopus.com/sourceid/7500153107</a>
Sandeep Rangrao Desai, Mangalsing Narsing Sonare	Automobile Engineering	Effect of fin density and fin height on flow-induced vibration behavior of finned tube arrays subjected to water cross flow	Multidiscipline Modeling in Materials and Structures	24-02-2023	1573-6105	<a href="https://www.scopus.com/sourceid/7100153127">https://www.scopus.com/sourceid/7100153127</a>
Pravin H. Yadav, Sandeep R. Desai, Dilip Kumar Mohanty	Automobile Engineering	Investigation on vibration parameters in aluminum finned tube arrays subjected to water cross flow	Multidiscipline Modeling in Materials and Structures	23-08-2022	1573-6105	<a href="https://www.scopus.com/sourceid/7100153127">https://www.scopus.com/sourceid/7100153127</a>
Pravin Hindurao Yadav, Sandeep R. Desai, Dilip Kumar Mohanty	Automobile Engineering	Fluid Elastic Instability and Vortex Shedding in Finned Tube Arrays: The Effects of Tube Material and Fin Density	World Journal of Engineering	29-11-2022	1708-5284	<a href="https://www.scopus.com/sourceid/21100305241">https://www.scopus.com/sourceid/21100305241</a>
Yogesh S. Patil, Aniket T. Suryawanshi, Surajkumar G. Kumbhar and Shirish S. Mane	Automobile Engineering	Implementation of a Team Game Tournament a Collaborative Learning Method and Study of its Impact on Learners' Development	Journal of Engineering Education Transformations (JEET)	Jan-23	2394-1707	<a href="https://www.scopus.com/sourceid/21100890669">https://www.scopus.com/sourceid/21100890669</a>
Supriya S. More, Dipali M. Kadam	Automobile Engineering	Effectiveness of Think Aloud Pair Problem Solving and Case Study based active Learning Techniques for Engineering Classroom	Journal of Engineering Education Transformations (JEET)	Jan-23	2394-1707	<a href="https://www.scopus.com/sourceid/21100890669">https://www.scopus.com/sourceid/21100890669</a>
Pankaj S. Ghatage and P. Edwin Sudhagar	Automobile Engineering	Free vibrational behavior of bi-directional perfect and imperfect axially graded cylindrical shell panel under thermal environment	Structural Engineering and Mechanics	Jan-23	1598-6217	<a href="https://www.scopus.com/sourceid/22062">https://www.scopus.com/sourceid/22062</a>
Pankaj S. Ghatage, P. Edwin Sudhagar	Automobile Engineering	Free Vibrational Behavior of Bi-Directional Functionally Graded Composite Panel with and Without Porosities Using 3D Finite Element Approximations	International Journal of Integrated Engineering	28-02-2023	2229-838X	<a href="https://www.scopus.com/sourceid/21100848408">https://www.scopus.com/sourceid/21100848408</a>
Sachin N. Sawant, Pankaj S. Ghatage, Sachin K. Patil	Automobile Engineering	An Attempt to Enhance the Visualization, Imagination and Drawing Skill of Freshman Engineering Students through Problem Based Learning Approach	Journal of Engineering Education Transformations (JEET)	Jan-23	2394-1707	<a href="https://www.scopus.com/sourceid/21100890669">https://www.scopus.com/sourceid/21100890669</a>
Aniket Suryawanshi, Yogesh Patil, Shirish Mane	Automobile Engineering	Enriching life-long learning Skills of Students by Poster Development and Presentation (PDP) Approach	Journal of Engineering Education Transformations (JEET)	Jan-23	2394-1707	<a href="https://www.scopus.com/sourceid/21100890669">https://www.scopus.com/sourceid/21100890669</a>



# Component Sizing of Electric Vehicles: A Programming Approach

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**Citation:** Pednekar, N. and Patil, S., "Component Sizing of Electric Vehicles: A Programming Approach," SAE Technical Paper 2022-01-5085, 2022, doi:10.4271/2022-01-5085.

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## Abstract

The rising demand for battery electric vehicles has resulted in market saturation in terms of various start-ups, and established automakers are also introducing new models every year. The automakers have to put a lot of effort into sizing powertrain components optimally to get the best performance and efficiency. This paper proposes a programming approach for estimating the preliminary component sizing based on analytical

equations regarding electric motor power rating and battery-pack energy capacity. Estimating tractive force for various vehicle performance goals dictates the motor power rating. The battery sizing for lead-acid and Li-ion batteries is proposed based on the empirical relationship between vehicle curb weight and battery-pack weight and the energy consumption approach. The validation and verification of the program based on output accuracy and user experience are presented.

## Keywords

Sizing, Electric vehicles, Battery capacity, C program, Motor rating

## I. Introduction

There are thousands of electric vehicles produced every year with BEVs accounting for 74% of EV sales [1] due to increased demand and environmental concerns regarding conventional internal combustion vehicles. More and more start-ups and established automakers are in a battle of designing and producing new electric vehicles. These automakers are held back by certain constraints such as time limitation, resource exhaustion, and expenses in research and development. While designing a new electric vehicle, certain parameters are to be considered such as traction battery-pack capacity, motor sizing and selection, and the like. These components directly affect range, cost, complexity, losses, and vehicle performance characteristics. An electric vehicle has fewer components and that is why component sizing in an electric vehicle becomes a crucial aspect in meeting optimal performance requirements.

Rigorous research has been going on in order to improve the relatively limited driving range of electric vehicles while having good performance without a major cost increase. Hence, it becomes important to investigate the effects on energy efficiency as well as performance that different design choices have when it comes to the design of primary powertrain components of an electric vehicle such as traction battery pack and motor. An interesting research aspect is to suggest

appropriate drive system components according to vehicle category and its performance requirements.

Till now, some studies have been done on the component sizing of electric vehicles. Mineeshma et al. [2] represented a backward simulation approach to choose optimal design specifications and performance for making an efficient EV/HEV system where component and vehicle requirements had to be defined in terms of range, gradeability, and the like to generate optimum component specifications. Unnewehr and Knoop [3] developed and presented a method for modeling electric vehicles that are used in the prediction of electric vehicle performance and range over variable driving cycles. The model could also be used for studying the size, power rating, and cost of the electrical drive train. Colzi et al. [4] used real-world driving avoiding standard cycles, where the data was collected on four different vehicles and was used as input to a longitudinal dynamic model of the vehicle, which was helpful in the preliminary sizing procedure. Sandeep et al. [5] presented a mathematical model for battery-pack sizing to evaluate the vehicle energy consumption. Factors such as battery mass and energy needed were predicted using inputs such as battery-specific energy, range, and so on. The outputs are evaluated and an ideal battery pack is suggested. Looking at the past work it can be seen that many have focused on

## NAAC Student Satisfaction Survey: A Reliable and Effective Instrument for Institutional Quality Assurance

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**Abstract:** The effectiveness of academic practices and hence student satisfaction in terms of academic engagement is a critical issue for any higher education institute. This work proposes the NAAC student satisfaction survey as a reliable and effective instrument to gauge the academic health of the institute. It demonstrates that the student feedback on the academic practices if analyzed and followed up with appropriate actions, helps improve the student satisfaction index at the institute level and that of departments. The work proposes the hypothesis that the improvement in the student satisfaction index of the institute over four years belongs to concerted efforts and actions taken based on annual survey findings. The hypothesis is tested with the help of ANOVA to validate the findings and conclusion of the work.

**Keywords:** NAAC student satisfaction survey; student satisfaction index; academic health; ANOVA

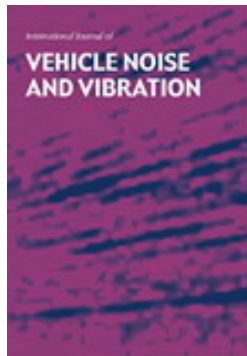
### I. INTRODUCTION AND LITERATURE REVIEW

Teaching-learning process is at the core of any teaching-intensive higher education institute. The effectiveness of this process directly influence the graduate outcomes in terms of placements, higher learning, research outputs or entrepreneurial efforts. Thus, assessment of teaching-learning process and the need for a metric indicating academic health of the institute becomes evident. Many institutes collect course-specific feedback from the students to gauge the academic effectiveness; however, a general feedback on teaching-learning, irrespective of faculty or the course, is desired to form an overall impression about the institutional academic ambience. Hence, student satisfaction in terms of academic engagement becomes pivotal for any higher education institute.

Earlier works have addressed student satisfaction issue in various contexts like evaluation of a new program or distance learning program, outcomes based pedagogy, effectiveness of vocational program, evaluation framework and some other. Daultani et al. (2021) identified key attributes of student satisfaction in the context of e-learning while Ghansah et al. (2021) investigated student satisfaction determinants for academic and administrative services of a private university. Silva et al. (2020) lends the students satisfaction perspective from Brazil about higher technical-vocational education. Garnjost and Lawter (2019) investigated undergraduate student perceptions across various pedagogies. Gunn (2018) addressed student satisfaction while developing a Teaching Excellence Framework (TEF) for a

university in UK. Skea (2017) presented his arguments on settling and unsettling of student expectations as a part of quality culture of an institute. Gibson (2010) reviewed the attributes which influence the students' perception of overall satisfaction. Möller (2006) presented development of a student satisfaction monitoring instrument at Utrecht University (UU) while Douglas (2006) designed and developed a questionnaire to measure student satisfaction at the faculty of business and law in a university. The abundant literature available also underlines the significance of the aspect of student satisfaction for a higher learning institute. The simplicity and reliability of the instrument used for the assessment of student satisfaction level is a key aspect.

The NAAC (National Assessment and Accreditation Council), a statutory body of UGC (University Grants Commission) is responsible for the institutional assessment and accreditation of higher educational institutes in India. The NAAC as a part of its standard process, uses Student Satisfaction Survey (SSS) - a twenty-one question questionnaire, to evaluate the teaching-learning process of the institute based on the feedback of the students. The NAAC conducts this survey online or through emails as a part of the assessment and accreditation process of the institute and offers five percent weight for the score. Out of twenty-one questions, twenty are objective while one is subjective in nature. These questions cover all the important and relevant dimensions of teaching and learning process like academic planning, course design and delivery, performance evaluation and feedback to the students. The student responses are sought on the five-point rating ranging from 0 to 4, indicating various levels of conformance to the statement. The questionnaire is available at [http://www.naac.gov.in/docs/Apply%20now/SSS-Questinnaire\\_Students.pdf](http://www.naac.gov.in/docs/Apply%20now/SSS-Questinnaire_Students.pdf) (2021). The student feedback collected offers insights into academic practices and culture; and help gauge the academic ambience of the institute though it doesn't provide feedback on individual course or course teacher. This work makes an effort to demonstrate leveraging NAAC Student Satisfaction Survey questionnaire as a reliable instrument to gauge academic health of an engineering institute and thereby improve the academic experience for its students. The findings are validated statistically with the help of ANOVA. Section 2 presents details about the deployment of the survey by the institute while section 3 presents the key findings based on the analysis of collected feedback. The 'Discussion' section discusses efficacy of this tool for academic health monitoring and further validated with the help of ANOVA in section 5 which is followed by the conclusion section.



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**Design and numerical investigation for reduction of hand-arm vibrations from steering wheel of an agricultural tractor**

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## Design and numerical investigation for reduction of hand-arm vibrations from steering wheel of an agricultural tractor

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**Abstract:** Steering wheel vibration affects the driver's comfort in an agricultural tractor. In order to increase driver comfort and reduce the hand-arm vibration syndrome (HAVS) effect, it is necessary to reduce the vibrations in agricultural tractors. The tuned mass damper concept is used to reduce vibrations from the tractor's steering wheel. The paper is focused on measuring steering wheel vibration characteristics on the actual tractor, designing a vibration control system and carrying out impact assessment using numerical analysis. The amplitude of vibration at the steering wheel measured by physical measurement on an actual tractor is compared to that determined using MATLAB Simulink. The outcomes of the numerical analysis suggest that the amplitude of vibration can be reduced by using a tuned mass damper (TMD) to achieve the proposed target levels. The effect of hand-arm vibration syndrome can also be decreased, resulting in an increased driver comfort.

**Keywords:** agricultural tractors; hand-arm vibration syndrome; HAVS; hand-transmitted vibration; steering wheel vibration; tuned mass damper; TMD; vibration exposure.

**Reference** to this paper should be made as follows: Naygaonkar, S.S. and Desai, S.R. (2022) 'Design and numerical investigation for reduction of hand-arm vibrations from steering wheel of an agricultural tractor', *Int. J. Vehicle Noise and Vibration*, Vol. 18, Nos. 1/2, pp.119–138.

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# Effect of fin density and fin height on flow-induced vibration behavior of finned tube arrays subjected to water cross flow

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Multidiscipline Modeling in Materials and Structures

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## Abstract

### Purpose

The prediction of critical velocity at instability threshold for shell and tube heat exchangers is important to avoid failure of tubes as a result of flow-induced vibrations due to water cross

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# Investigation on vibration parameters in aluminum finned tube arrays subjected to water cross flow

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## Abstract

**Purpose** – Predicting the critical velocity is crucial at the instability threshold for shell and tube heat exchangers in order to prevent tube failure due to vibrations. In this study, the vibration response of an aluminum tube bundle subjected to water cross flow was analyzed experimentally. Aluminum tubes are preferred over steel tubes because of aluminum tubes' excellent corrosion resistance, ease of manufacture, and high thermal efficiency.

**Design/methodology/approach** – The fluid elastic instability and vortex shedding mechanisms in a finned tube array of aluminum tubes with a base tube diameter of 19.05 mm and pitch of 34 mm were investigated. The current study considers parallel triangular finned tube arrays with fin heights of 3 mm and 6 mm with a uniform fin thickness and fin pitch. The plain tube array was tested to compare the finned tube array results. The tube vibration response was measured using an accelerometer mounted on the middle tube of the third row. In order to define the fluid elastic instability behavior of various tube arrays, the critical velocity at the instability threshold is measured. By finding the Strouhal number at the small peaks before instability, the vortex shedding behavior of the tube arrays is examined.

**Findings** – The results reveal that the critical velocity at instability for coarse finned tube arrays increases as the fin height increases. The effect of the tube material is evaluated by comparing the results with those previously reported for parallel triangular tube arrays made of steel. Finally, the occurrence of vortex shedding in a tube array is confirmed based on the Reynolds number and Strouhal number relationship. The instability constant  $K$  for the plain tube array of steel and aluminum material are 4.97 and 4.87, respectively.

**Originality/value** – This paper provides the research findings on the effect of fin height on coarse density finned tube array. This will add substantial knowledge to the literature in the field of fluid elastic instability and vortex shedding, which is needed for the safe functioning of shell and tube heat exchangers.

**Keywords** Critical velocity, Fluid elastic instability, Coarse fin tube array, Vortex shedding

**Paper type** Viewpoint



## Nomenclature

$A$	Test section cross-sectional area ( $\text{m}^2$ )	$d_b$	Tube external diameter (mm)
$A_g$	Amplitude of vibration in terms of "g" ( $g = 9.81 \text{ m/sec}$ )	$d_f$	Diameter of fin (mm)
$A_m$	Amplitude of vibration (mm)	$d_{\text{eff}}$	Tube effective diameter (mm)
$c$	Damping coefficient	$D_e/D$	Confinement factor
$d_i$	Tube internal diameter (mm)	$E$	Young's modulus of elasticity ( $\text{N/m}^2$ )
		$f_n$	Tube natural frequency in the air (Hz)

# Fluid elastic instability and vortex shedding in finned tube arrays: the effects of tube material and fin density

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## Abstract

**Purpose** – The purpose of this paper is to present investigations on the significant influence of the tube material and fin density on fluid elastic instability and vortex shedding in a parallel triangular finned tube array subjected to water cross flow.

**Design/methodology/approach** – The experiment was conducted on finned tube arrays with a fin height of 6 mm and fin density of 3 fins per inch (fpi) and 9 fpi. A dedicated setup has been developed to examine fluid elastic instability and vortex shedding. Nine parallel triangular tube arrays with a pitch to tube diameter ratio of 1.78 were considered. The plain tube arrays, coarse finned tube arrays and fine finned tube arrays each of steel, copper and aluminium materials were tested. Plain tube arrays were tested to compare the results of the finned tube arrays having an effective tube diameter same as that of the plain tube.

**Findings** – A significant effect of fin density and tube material with a variable mass damping parameter was observed on the instability threshold. In the parallel triangular finned tube array subjected to water cross flow, a delay in the instability threshold was observed with an increase in fin density. For steel and aluminium tube arrays, the natural frequency is 9.77 Hz and 10.38 Hz, which is close to each other, whereas natural frequency of the copper tubes is 7.40 Hz. The Connors' stability constant  $K$  for steel and aluminium tube arrays is 4.78 and 4.87, respectively, whereas it is 5.76 for copper tube arrays, which increases considerably compared to aluminum and steel tube arrays. The existence of vortex shedding is confirmed by comparing experimental results with Owen's hypothesis and the Strouhal number and Reynolds number relationship.

**Originality/value** – This paper's results contribute to understand the effect of tube materials and fin density on fluid elastic instability threshold of finned tube arrays subjected to water cross flow.

**Keywords** Natural frequency, Water cross flow, Parallel triangular tube array, Stability constant, Tube material

**Paper type** Research paper

## Nomenclature

$A$	= Test section cross-sectional area ( $m^2$ );
$A_g$	= Amplitude of vibration in terms of "g";
$A_m$	= Amplitude of vibration (mm);
$d_i$	= Tube internal diameter (m);
$d_b$	= Tube external diameter (m);
$d_f$	= Fin diameter (m);
$d_{eff}$	= Tube effective diameter (m);
$D_e/D$	= Confinement factor;
$E$	= Young's modulus of elasticity ( $N/m^2$ );
$f_n$	= Tube natural frequency in air (Hz);
$f_w$	= Tube natural frequency in water (Hz);
$K$	= Connors' stability constant;

$m$	= Tube mass (kg/m);
$m_t$	= Tube structural mass (kg/m);
$X_p$	= Tube pitch ratio;
$m_h$	= Tube hydrodynamic mass (kg/m);
$M_r$	= Mass ratio;
$P$	= Pitch between the tube (m);
$P/D_{eff}$	= Effective pitch ratio;
$p_f$	= Fin pitch (mm);
$Q$	= Flow rate ( $m^3/h$ );
$t_f$	= Fin thickness (m);
$V_f$	= Free stream velocity (m);
$V_g$	= Gap velocity (m);
$V_c$	= Critical gap velocity (m);
$\delta$	= Logarithmic decrement;
$\rho$	= Mass density of the tube ( $kg/m^3$ );
$\rho_f$	= Mass density of the fluid ( $kg/m^3$ );
$\alpha$	= Connors' exponential constant; and
$\zeta$	= Damping factor.

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## Implementation of a Team Game Tournament a Collaborative Learning Method and Study of its Impact on Learners' Development

Yogesh S. Patil, Aniket T. Suryawanshi, Surajkumar G. Kumbhar and Shirish S. Mane  
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**Abstract**— The paper showcases the encouraging results of the cooperative learning (CL) method Team Game Tournament (TGT). TGT helps students to improve and accelerate their learning. In TGT success of the team is dependent on the success of the individual [5]. A tournament is played between small academically balanced teams. Facilitators form such teams and note the performance of each team by visual monitoring, data from student questionnaires, and exam results. Exam results of Third Year Automobile course Machine Design (AE301) with and without TGT are compared. Students' performance in exams is improved, they show to be focused and participative, to develop their critical thinking. Because of TGT, deep discussions happened on topics by students in a group. They enjoy the new learning format. Social skills like teamwork and managing conflict are developed in students. Students' feedback and improvement of their performance in exams confirm the above perceptions.

**Keywords**— Cooperative learning, Team Game, Tournament (TGT), Student attitude.

**JEET Category**—Practice paper

### I. INTRODUCTION

In Cooperative learning (CL) students work in small groups to help each other learn. CL helps a student to learn the material better due to the facility to share their knowledge and discuss it with the team. It also improves the social and cooperative behavior of learners. The subject AE301 is a traditionally difficult subject. Students suffer to understand, remember and apply the number of design processes discussed in the subject. Many work on selective topics to earn a passing percentage. Slow learners find it difficult to pass the course on the first attempt. Few advanced learners only achieve excellence in it. Therefore, the new learning method needs to provide the student with an ability to efficiently work as part of a team in addition to facilitating an early and thorough grasp of concepts. In Cooperative Learning (CL) students attain their learning outcomes through team activities. The success of CL depends upon the following elements [1, 2].

- i *Accountability of individual in group success*: the success of a group is dependent on the performance of each member of the group.
- ii *Group Accountability*: The contribution of each member is accountable so members help each other.
- iii *Encouragement to each other*: Group members encourage each other to achieve goals.
- iv *Social Skills*: Skills like leadership, communication, managing conflict, and building trust are getting developed in students.
- v *Group Processing*: Group members prepare a plan to study material and to find out all possible questions and answers.
- vi *Group structure*: Heterogeneous mix of students in a group conforms to fair competition.
- vii *Equal Opportunities for Success*: Every group and student gets an equal opportunity to score because of the TGT structure.

The students participate in TGT more actively because:

- i they get an award when the group wins,
- ii they get recognition in school/class,
- iii interaction with peer help them to understand the concepts.
- iv by explaining to others they understand better.
- v even after an initial loss, they get a chance to excel.

Here TGT is chosen to be implemented in AE301.

### II. TGT PROCESS

In the early '70s, DeVries & Edwards developed TGT [6-8]. In TGT teams are formed as per the ranking of the students. Competition between similar ranking students of different teams takes place [9]. The facilitator prepares questions and answers in card format. He puts cards on each table. In each table, one of the students reads the question, and the other students can "pass" or "challenge" the question. If the challenger gives the correct answer, then he/she and his/her team get a score. For every question role of the student changes. The current nature of TGT is not suitable for AE301 because of its nature. In AE301 calculations are required so some modifications are made to a traditional method.

# Effectiveness of Think Aloud Pair Problem Solving and Case Study based Active Learning Techniques for Engineering Classroom

Supriya S. More, Dipali M. Kadam

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**Abstract**— Engineering and Technology is a very dynamic sector and change is very rapid. The knowledge gained in traditional classrooms, through online lectures, through search engines, online video books, and Wikipedia is just helping to understand the theoretical concepts. These information sources cannot develop abilities to apply the theoretical concept to real-world problems. This can be developed through experiential learning in workshops, industrial visits, field visits, etc. The advanced courses are not having this scope due to limited lab capacities, high instrument costs, a variety of instruments, quick revisions in technology, less number of industries, IP securities, and many more reasons. The Automobile sector is a vibrant one and the Automobile Engineering department is always facing these issues. This study presents the teaching-learning experience of the course Automotive Control Engineering which faces the above issues. The study was conducted for T.Y.B.Tech Automobile Engineering students for the years 2018-19. The aim of the study was to increase the concept implementation ability of the students. The theoretical knowledge that was being received through books, lectures, and search engines were used to correlate the working of advanced technology. Think Aloud pair problem-solving technique (TAPPS) and case study presentation of the real-world system tools have been used for the course delivery. The course attainment level of the experimental group increased by 11%. The students have shown enhancement in competencies like problem-solving, application of theoretical concepts, critical thinking, lifelong learning, etc. Learning from peers and in groups also improved classroom engagement and the joy of learning.

**Keywords**— Active learning; Control Engineering; Life-long learning; OBE; Problem based learning; Think Aloud Problem Solving Technique.

*JEET Category*— Research

## I. INTRODUCTION

Automotive is ever changing field of Engineering and technology. The control system plays a key part in

efficient and safe working of an automotive system. It becomes inevitable to learn concepts of automotive control for Automobile Engineering students. Automotive control and allied industries are the most fascinating pocket for an automotive engineer. Teaching Control Engineering course to Automobile Engineering students is a challenging task, as students have not studied the basics of electronics and the advanced, emerging technologies are complex and setting new trends day by day (Govindasamy, 2001; Shulman, 1986). This is an era of transformation and engineering education field is also started transforming from the conventional chalk and talk method of teaching learning to outcome based design, delivery, and assessment of curriculum (Jwaid, Clark, & Ireson, 2014; Archambault & Barnett, 2010). The domain-specific engineering education is all about developing the problem solving skills by applying theoretical knowledge they learnt. Nowadays various cooperative and collaborative active learning techniques like think-pair-share, jigsaw, project-based learning, STAD, puzzle-based, and problem based learning are used to make classroom learning more effective so that students themselves demonstrate the skills by active participation. Various task-based activities with proper planning and execution make classroom learning more effective as they are based on ‘learning-by-doing’ principle (Hayne, 2011). The methods like reciprocal and modified reciprocal teaching (Alfassi, 1998; Kadam & Sawant, 2020) are effectively used as peer learning techniques.

There are many evidences in literature in which different concepts are worked out and experimented for delivery of control engineering course (Govindasamy, 2001). The Technological Pedagogical Content Knowledge (TPACK) method of learning has been used which helped to communicate fresher with specialist (Chilukuri, 2020). The Visual literacy aids like the intuitive approach adopted and implemented successfully some specially designed tracks for better learning of this course are documented (Bencomo, 2004; Krathwohl 2002; Pantoya, Hughes, & Hughes, 2013). Problem solving technique and case study approach have been also implemented for enhancing course delivery and classroom engagement of engineering courses (Johnson & Chung, 1999; Kani & Shahrill.

# Free vibrational behavior of bi-directional perfect and imperfect axially graded cylindrical shell panel under thermal environment

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**Abstract.** This study presents the free vibrational responses of bi-directional axially graded cylindrical shell panels using 3D graded finite element approximation under a temperature field. The cylindrical shell panel is graded in two directions and made of metal-ceramic materials. To extract material properties, the Voigt model is combined with a Power-law material distribution. Convergence and validation studies are performed on the developed computational model to ensure its accuracy and effectiveness. Furthermore, a parametric study is performed to evaluate the developed model, which demonstrates that geometrical parameters, imperfect materials (porosity), support conditions, and surface temperature all have a significant impact on the free vibration responses of a bi-directional axially graded cylindrical shell panel in a thermal environment.

**Keywords:** 3D elasticity theory; FEM; free vibration; functionally graded materials; porosity

## 1. Introduction

Functionally graded materials (FGMs) are sophisticated materials that fall under the umbrella of composites, consisting of the gradation of properly tailored properties to achieve desired characteristics. Material property variations can be one-directional or multi-directional, and they can be graded continuously or discontinuously. The generally used FGMs are unidirectional and continuously graded Swaminathan and Sangeetha (2017). However, multidirectional functionally graded composite materials have attracted growing interest in aviation as well as other engineering applications due to their enormous advantages over conventional laminated composites and unidirectional FGMs. The cylindrical structure is well-known as one of the most common structural components in engineering applications Dai *et al.* (2016). Hence, researchers have paid more attention to estimate the free vibration behavior of FG cylindrical structures with the help of numerical, analytical, and experimental approaches in the last few decades.

Pradhan *et al.* (2000) conducted a vibrational analysis of a unidirectional FG cylindrical shells considering various boundary conditions. Kadoli and Ganesan (2006) used first-order shear deformation theory (FSDT) and presented thermal buckling and the linear free vibrational behavior of 1D-FG cylindrical shells with clamped-clamped boundary condition.

Free vibration behavior of non-homogeneous FG

magneto-electro-elastic cylindrical shells in conjunction with the finite element approach was investigated by Bhangale and Ganesan (2005). Pradyumna and Bandyopadhyay (2008) investigated the free vibrational behavior of unidirectional FG curved structures, including cylindrical shells using a higher-order FEM approach. Tornabene (2009) conducted a free vibrational analysis of a one-directional FG conical and cylindrical shells based on FSDT. A four-parameter power-law index is used to grade the material in the thickness direction. Tornabene *et al.* (2009) studied the vibrational behavior of one-directional FG conical and cylindrical shells along with annular plate structure using FSDT, the results were compared with results obtained from different commercial software. Zhao *et al.* (2009) used an element-free KP-Ritz technique and FSDT to investigate the static response and vibrational behavior of a unidirectional FG cylindrical shell under mechanical and thermomechanical loads. Li *et al.* (2010) studied the free vibration of a triple-layered cylindrical shell with a unidirectional FG middle layer. Malekzadeh and Heydarpour (2012) used FSDT to study the free vibrational behavior of a FG spinning cylindrical shell in a temperature environment. Fantuzzi *et al.* (2016) proposed three different two-dimensional and three-dimensional models to analyze the free vibration of unidirectional FG cylindrical and spherical panels and compared them to show the limitations of the two-dimensional model. Haddadpour *et al.* (2007) conducted a free vibrational study of a unidirectional cylindrical shell while taking temperature-dependent material characteristics into account. The power law index's influence on natural frequencies in a thermal environment was demonstrated. Punera and Kant (2017) performed a free vibrational study of unidirectional FG open cylindrical shells using models of higher-order shear and normal deformation theory (HOSNT), first-order shear deformation

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# Free Vibrational Behavior of Bi-Directional Functionally Graded Composite Panel with and Without Porosities Using 3D Finite Element Approximations

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**Abstract:** The frequency characteristics of bi-directional functionally graded (FG) rectangular panels with and without porosities are examined in this work using 3D finite element approximations. The properties of graded panel consist metal and ceramic material varied smoothly in bi-direction. The material properties of this highly heterogeneous material are obtained using the Voigt material model and Power-law. The present model is developed using a customized computer code and discretized using three-dimensional solid 20-noded quadrilateral elements. The mesh refinement is conducted to present the convergence test. The validation test is presented by showing comparison of the obtained findings with the results reported in the previous literature. At a later stage, comprehensive parametric research is presented through numerical illustrations which reveal that the geometrical and material parameters of bi-directional functionally graded panel affect its frequency characteristics, significantly. Finally, the developed 3D FEM model to predict the free vibrational characteristics of multidirectional FG rectangular plates with and without porosities will be the reference for the continuation of research in this area.

**Keywords:** Bi-directional FGs, free vibration, finite element approximation

## 1. Introduction

Recently, multidirectional functionally graded composite materials show significant improvement in their characteristics, which results in attracting considerable attention in aerospace as well as other engineering application because of their enormous advantages over laminated composites and unidirectional functionally graded materials (FGMs). Koizumi [1] had proposed the idea of FGM in Japan for producing thermal barrier materials, in the 19<sup>th</sup> century many researchers had contributed to the development of unidirectional FGMs but some modern structures like advanced space crafts, shuttles, etc. demand advanced FGMs, whose micromechanical properties should vary not only in one direction but also vary in two or more than two directions and hence the concept of multidirectional FGMs was introduced in plate structure in which the micromechanical properties graded in two or more than two directions from one surface to another. FGM structures are typically composed of a grouping of metal and ceramic, metals exhibit good strength and toughness while ceramic materials are having good anti-oxidant as well as thermal resistance behavior. Free vibrational behavior of plate structure is one of the important concerns for structural designers; hence various researches have been conducted to evaluate the free vibrational behavior of FGM structures [27-29], whereas in recent decades, a group of researchers has worked to model and analyze multi-directional FGM structures [2-10].

# An Attempt to Enhance the Visualization, Imagination and Drawing Skill of Freshman Engineering Students through Problem Based Learning Approach

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**Abstract**— The Engineering Drawing is one of the important and compulsory course for all the engineering students in first year engineering. This course improves the visualization, imagination and drawing skill of the students which are helpful them to draw their ideas clearly and rapidly, to read the drawing drawn by others and to create successful design. Engineering Drawing course includes projection, section and development of solids in which students are expected to imagine, visualize and develop the drawing as per given conditions also it includes orthographic projections in which 3D objects are required to convert in 2D drawing. The students of first year engineering find this task difficult due to no prior basic knowledge of technical drawing, poor imagination and visualization skill. Hence the attainment of the course learning outcome related to these topics is recorded low. To overcome this problem, a problem based learning approach implemented along with classroom teaching in order to enhance the, visualization, imagination and technical drawing skill of first year engineering students. In this article, the author has presented the efforts taken to improve the visualization, imagination and drawing skill through active engagement of students for learning in the classroom and outside of classroom. Due to systematic implementation of problem based learning (PBL), student's engagement towards learning, attainment of the course outcomes (COs) and overall exam result of the course have been improved.

**Keywords**— Course Learning Outcome, Engineering Graphics, Engineering Drawing, Problem Based Learning

**JEET Category**—Engineering Education for sustainable development

## I. INTRODUCTION

Engineering drawing is a universal technical language of an Engineers which is globally accepted technical language to communicate between engineering professionals. Based on Engineering drawing skill Engineers can able to create designs, represents them on drawing sheet and finally prepare blue print before the manufacturing (Murthy et al., 2015). The ability to understand important topics in engineering drawing such as orthographic projection, isometric drawing, hidden views, and

sectional views are very critical as it represents the fundamentals of engineering drawing education (Serdar and De Vries ,2020). Engineering drawing is the compulsory course in first year engineering class to improve the drawing and imagination skill of the students, however due to lack of prior basic knowledge of technical drawing, poor imagination skill of the students and time restrictions in the classroom teaching, it is challenging for the faculty members to train the students for good drawing skill with conventional teaching methodology. Hence many faculty members implemented innovative teaching methodologies. Murthy et al. (2015) implemented Augmented Reality (AR) as a tool for teaching Engineering Drawing and improved 3D visualization of the students. Chen et al. (2011) developed tangible and AR models for Engineering Drawing course to increase the learning interest of students and to improve the visualization of the students. Pucha and Utschig (2012) implemented learning-centered strategies like case studies and real-world problems for freshman engineering students while teaching Engineering Drawing course. Authors have presented the impact of the learning-centered strategies on students learning, engagement and performance. Soundattikar and Naik (2016) conducted case study while teaching Total Quality Management course. They found that case study is effective tool for engaging students with different learning styles. Perumaal (2018) created effective learning environment for the course Engineering graphics through different active learning activities to improve the spatial visualization of students. Govil (2021) introduced sketching as an iterative tool in engineering education to improve visual communication skill of the students. Shreeshail et al. (2021) implemented problem-based learning technique to impart engineering drawing standards. Zemke (2018) discussed case study on efforts taken to teach Engineering Graphics for blind students. The author has presented the progress of blind students while learning orthographic and isometric projections. Moyano et al. (2009) presented the case study on Engineering Graphics learning, author evaluated the prior knowledge and background of the freshman engineering students. Author concluded that the rate of students' cognitive development does not follow the efforts

# Enriching life-long learning Skills of Students by Poster Development and Presentation (PDP) Approach

Aniket Suryawanshi, Yogesh Patil, Shirish Mane.  
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**Abstract**— In recent years' students are very reluctant to read books for studying for any course. They are preferring only teachers' notes or PowerPoint slides and mobile apps for exam study. Any type of information or study material is easily available on various networking sites. This can lead to poor interest and less engagement of students in the classroom teaching learning process. Also, in class activities are not fulfilling the expected level of learning of students, especially in the conceptual courses. So students need an activity based learning approach in the classroom. Nowadays most of the teachers in engineering institutions face these challenges. Hence, to utilize the capabilities of students, make them aware of course related books and achieve expected level of learning of students, a poster presentation module was implemented. In this practice paper, implementation of poster development and presentation (PDP) to improve learning of course fluid mechanics and machineries is detailed. This PDP approach empowers the student in life-long learning skills.

**Keywords**— Poster development and presentation, assessment, book reading, life-long learning.

## **JEET Category**— Research Paper

Poster presentations are commonly used for assessment in the all disciplines of education, this is an innovative approach of assessment in disciplines such as business, law, and the humanities. Posters have the ability to demonstrate reflection in learning and are an excellent demonstration of experiential learning and assessing authentically.

An educational poster is a tool that enables visualization in the classroom to foster student learning. A great example is an educational poster in the format of an infographic. An infographic is a collection of imagery, charts, and minimal text that gives an easy-to-understand overview of a topic.

The main function of a poster is to capture a moving audience with a message. When designing a poster, plan its design carefully. Within a short amount of time posters will attract audience and hold attention.

The best advantage of poster making is that it facilitates team work and understanding along with facilitating creative thinking. It provides students with an opportunity to learn by doing, in turn strengthening the learning.

The basic purpose of this activity that students can synthesize information visually at a glance on one page. Poster should be self-demonstrated so anyone can understand the concept. The prepared poster can help student in the exam study. The poster will present the individual learning of students.

The purpose of these activities is to get students out of being passive audience and observers and to keep the student into the learning-teaching phenomenon in person. But it is not only to participate simply in the learning process for the learners but also to encourage them to use their mental abilities, to think themselves, to comment on learned topics, and to make relevant decisions in the learning process. The student is actively involved in the learning process, directs his / her own learning, uses high-thinking and decision-making skills, and engages in cooperation with friends.

Posters include original studies that the students perform on a specific topic with their friends in the classroom. Thus, an authentic learning environment is created in the classroom. In such an environment, students involve in their own activity and they are also in an active process. Therefore; the students learn the knowledge permanently by keeping their learning alive on their own. Thus, the students use library resources effectively, develop critical thinking, group work and presentation skills.

Individual presentations improve the validity of an assessment as it is easier to gauge the performance of students individually. As Dunn et al. point out "an assessment task is considered to be valid if it permits a student's performance, on what has actually been taught, to be measured: a task would be valid if it measures what the teacher intended it to measure." Individual assessments are necessary to evaluate the efficacy of a course as well as the progress of students enrolled in the course.

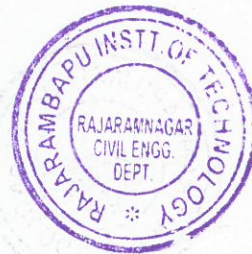
## I. MOTIVATION OF ACTIVITY

In this paper, the authors have introduced an assessment method that motivates students, encourages them to relate Fluid Mechanics and Machineries course with other fields. This paper describes an innovative approach of the poster presentation to these challenges that involve a mixture of traditional and modern assessments. Creating and presenting

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**3.4.3 Details of research papers per teacher in CARE Journals notified on UGC website during the year**

Name of the Author(s)	Dept. of the Author(s)	Title of the Paper	Name of the Journal	Month and Year of pub.	ISSN	Link to the notification in UGC enlistment of the Journal
Sana D. Sayyad, Dr.H.S.Jadhav	Civil Engg.	Artificial Neural Network approach for assessment of residual compressive strength of geopolymer concrete exposed to elevated temperature	YMER	Sept 2022	ISSN : 0044-047	
Ansar Allauddin Mulla, Dr. H. S. Jadhav, Dr. A. P. Shah	Civil Engg.	A case study on course outcome and program outcome mapping levels based on competency and performance indicator.	Journal of Engineering Education Transformations	Jan 2023	ISSN 2394-1707	
Dr. P.D. Kumbhar, A.M. Jamadar	Civil Engg.	Comparative study on load carrying capacities of castellated beams provided with mild steel and CFRP stiffeners	Materials Today: Proceedings journal	Mar 2023	ISSN: 2214-7853	
Shweta R. Patrekar, Dr. Popat D. Kumbhar	Civil Engg.	Development of Interaction Surfaces for Rcc Columns Subjected to Axial Load and Biaxial Bending Reinforced with Fe550 Steel	The Indian Concrete Journal	May 2023	ISSN: 00194565	
Sachin B Khot, Sachin K Patil, Dr. Sushma S Kulkarni	Civil Engg.	A novel way to designing the undergraduate mechanical engineering curriculum using active stakeholder participation	Journal of Engineering Education Transformations	Jan 2023	ISSN: 2349 - 2473	



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Name of the Author(s)	Dept. of the Author(s)	Title of the Paper	Name of the Journal	Month and Year of pub.	ISSN	Link to the notification in UGC enlistment of the Journal
Pratik A Patil, Sachin K Patil, Dr. Sushma S Kulkarni	Civil Engg.	Inculcating Design Thinking Methodology in the Minds of First Year Engineering Students: A Step Towards Entrepreneurial Thinking	Journal of Engineering Education Transformations	Jan 2023	ISSN: 2349 - 2473	
Satyajit R Patil, Dr. Sushma S Kulkarni	Civil Engg.	NAAC Student Satisfaction Survey: A Reliable and Effective Instrument for Institutional Quality Assurance	Journal of Engineering Education Transformations	Jan 2023	ISSN: 2349 - 2473	
Dr. Y. M. Patil, Dr. P. D. Kumbhar	Civil Engg.	Effectiveness in Jigsaw Strategy on Student Achievement in Engineering Education	Journal of Engineering Education Transformations	Jan 2023	ISSN: 2349 - 2473	
Patil Y. M., Kumbhar P. D.	Civil Engg.	Improving of Placements, Higher Studies and Entrepreneurships of Civil Engineering Students through Quality Circle Activity	Journal of Engineering Education Transformations	Jan 2023	ISSN: 2349 - 2473	
Kanchan DeoliBahukhandi, Anamika Kushwaha, Lalit Goswami, Uday Bhan, Vishal Kamboj, Nitin Kamboj, Aditi Bisht, Amit Kumar Sharma, Sandip S. Sathe, Vipin Kumar Saini, and Bhavtosh Sharma	Civil Engg.	Hydrogeochemical Evaluation of Groundwater for Drinking and Irrigation Purposes in the Upper Piedmont Area of Haridwar, India	ACS ES&T Water	May 2023	ISSN: 2690-0637	





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**Department of Civil Engineering**

Name of the Author(s)	Dept. of the Author(s)	Title of the Paper	Name of the Journal	Month and Year of pub.	ISSN	Link to the notification in UGC enlistment of the Journal
S.D. ZimurPratapsingh Gaikwad A.V. Mali Amit Prakash Patil d S.H. Burungale P.D. Kamble	Civil Engg.	Magnetic and structural characterization of Sn doped cobalt ferrites; A visible light-driven photocatalysts for degradation of rhodamine-B and modeling the process by artificial intelligence tools	Journal of Alloys and Compounds	Jun 2023	ISSN: 0925-8388	
Shruti A. Brahme Prof. Pramod B. Salgar	Civil Engg.	Seismic Comparison of flat slabs and conventional slabs for structure with irregular shapes	YMER	Sept 2023	ISSN : 0044-047	



Head, Civil Engineering Department



# Artificial Neural Network approach for assessment of residual compressive strength of geopolymer concrete exposed to elevated temperature

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## Abstract

The population growth and industrial activities nowadays creates a considerable volume of rubbish, producing disposal challenges and major environmental hazards. The cement industry is a major generator of greenhouse gases like carbon dioxide. The use of waste resources, which avoids disposal worries while lowering greenhouse gases emissions into the atmosphere. This is a major reason for the advancement of cement-free Geopolymer Concrete. Fly ash (FA) and ground granulated blast furnace slag (GGBS) geopolymer concrete cubes were treated to various temperatures ranging from 27 °C to 800 °C in a 75:25 ratio. The mechanical properties were then evaluated. This study demonstrates the use of an Artificial Neural Network (ANN) approach to calculate the 28-day compressive strength of Geopolymer concrete (GPC) from input materials. 255 test examples from previously published studies were used for training, testing, and verifying the ANN model. Non-Destructive tests (NDT), Rebound Hammer (RH) and Ultrasonic pulse velocity (UPV) were done at the same curing age to confirm the compressive strength estimated by the Destructive test. A test project was also built to collect experimental data for testing the prediction capacity of the ANN model. According to the study's findings, the ANN model applying the "trainlm" learning strategy generated the highest predictive results. The unseen set of data had a prediction error of about 3.5MPa on average.

**Keywords:** compressive strength, elevated temperature, geopolymer concrete, artificial neural network

## A Case Study on Course Outcome & Program Outcome Mapping Levels Based on Competency & Performance Indicators.

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**Abstract**— This Paper gives an insight into an essential part of practicing outcome-based education (OBE). One of the crucial parts of OBE is measuring the quality and quantity of Program learning skills that student has acquired through various assessments. Course Outcome attainment heads up the learning in a specific course. However, the Program Outcome (PO) attainment needs the relation of Course Outcome & Program Outcome (CO-PO), i.e., mapping levels for calculations. The author has demonstrated the CO-PO mapping level underpinning the competency and Performance Indicators. The methodology for CO-PO Mapping has been shown in the Paper. A review on Mapping has been taken on an online feedback survey and found that mentoring is required in the CO-PO mapping level and interpreting it at hard-shell. CO-PO Mapping for a course has been demonstrated w.r.t. the process followed, and calculations to the end have been explained. There is an opportunity to take PO assessment methods further with mapping levels concentrating on defining competencies and Performance Indicators.

**Keywords**—Course Outcome (CO), Program Outcome (PO), CO-PO Mapping, Competency, Performance Indicators OBE.

**JEET Category**—Choose one: Research, Practice, or Op-Ed. (Please note, Op-Eds are by invite only. Refer to the Paper Submission and Review Guidelines for more details.)

### I. INTRODUCTION

THE teaching-learning process is the heart of any educational system at a level and takes the stakes to their wisdom. Outcome-based education has emphasized the same, and the focus of learners' learning is at the center of the teacher's teaching.

In outcome-based education, the education focuses on learners' skill development at Cognitive, Psychomotor, and Attitude levels. The above skill level varies with education streams and level of education from school to higher education colleges & universities. (Mulla, 2021) While implementing outcome-based education ensures a certain amount or level of measurement quality has been imparted to the learner.

Measuring of quality of education imparted to students leads to the assessment and evaluation of learning by students in examinations (Yuet Yen Wong, 2015). AICTE has been defined and guided through Examination reforms and Policies,

which also support better assessment in studies, measuring outcomes at the course and program levels. Model question papers that will help in the evaluation program skills incorporated by a student.

Exam Reforms (REFORMS, 2018) this reform has guided the Assessment strategy for outcome-based Education (OBE). It suggested a two-step process bringing clarity to PO, Mapping PO to examinations/examination tools, what skills competencies curriculum of a program develops, and performance indicators through which can assess these competencies. Examination tools that evaluate higher-order abilities and professional skills are also demonstrated (Dr. A. Kavitha, 2018).

It becomes abstruse to justify the CO-PO mapping level defined by the course teacher. There becomes a necessity for scientific or any statistical relevance that will rigid the CO-PO mapping level. The Mapping of the CO-PO level concerning Competency and Performance Indicators makes it a cakewalk for the course in charge to demonstrate for a third person.

Competencies are simplified statements that focus on different abilities to be attained by the learners. These are Domain-specific and can be used to assess the student's learning ability.

Competencies are statements that showcase what students demonstrate concerning PO from the program curriculum. Each PO and Program Specific Outcome (PSO) can be implied by an ability that is needed to be shown by the program student/learner. This demonstrative ability requires assessment procedures, creating a shared understanding that students want to achieve through their respective programs. A program needs to identify what competencies and various skills can be built in students concerning each PO, these competencies will give an idea for performing indicators through which we can measure these competencies, and subsequently, the quality of PO can be measured.

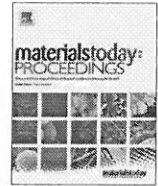
Performance Indicators (PI) - Measuring tool in Assessment, Performance Indicators are the statements used to evaluate various competencies; they can be designed to find the appropriate level of Competency of each indicator so that instructors can target and students can achieve the acceptable level of proficiency

A feedback survey has been taken, and an understanding of CO-PO mapping levels and how mapping levels are justified is analyzed. The next section describes the feedback survey



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## Comparative study on load carrying capacities of castellated beams provided with mild steel and CFRP stiffeners

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### ARTICLE INFO

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Carbon fiber reinforced polymer  
Mild steel  
Stiffeners  
Abaqus  
Load-carrying capacity

### ABSTRACT

This paper focuses on determining load-carrying capacity of castellated beams provided with transverse stiffeners of mild steel (MS) and carbon fiber reinforced polymer (CFRP) under two-point loading using ABAQUS software and comparing them with control beam. Results indicate that the load-carrying capacity of beams get enhanced due to transverse stiffeners of both materials. The variation in load carrying capacities of beams with MS and CFRP stiffeners is found to be only 8%. However, the load carrying capacities of beams provided with both types of stiffeners is found to be more by an average value of 10.65% over control beam. Further, the deflection of beam with CFRP stiffener is found to be less by 12.04% and 16% less as compared to the deflections of control beam and the beam with MS stiffeners respectively. The study concludes that the CFRP stiffeners can be preferred over MS stiffeners as they contribute in increasing load-carrying capacity with weight reduction and ease of application.

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### 1. Introduction

The requirements of steel and composite structures for maximum space utilization, efficiency during construction and cost-effectiveness demands the use of long-spanned, shallow, light-weight steel beams [1]. In the modern building constructions, the spans are becoming longer and one way of fulfilling these demands is to use castellated beams. The concept of producing single web openings in wide-flange steel beams for passing the service lines through the beam goes back to the early use of steel sections. The steel beams with expanded web sections and repeating openings in the web were first used in 1910 by the Chicago Bridge and Iron Works [2]. In 1935, this concept of providing web openings in the steel beams was also developed independently in Argentina and later it was patented in the United Kingdom. The patent was granted to Geoffrey Murray Boyd because of which it was called at that time the Boyd beam. Later this name was changed to castellated beam as its appearance and similarities were found to be similar with castle fortifications. The castellated beams are typically consisting of hexagonal or octagonal openings.

In the 1940s, use of castellated beams was considerably increased throughout the Europe mostly due to the overall lack of steel rolled sections because of the World War II. However, such beams could be efficiently produced by steel mills into larger sections by employing manual methods for expanding steel beams due to the low labour-to-material cost ratios [2]. Further, it was possible to design the castellated beams of lighter sections with subsequent cost saving in foundations due to their versatile property for high strength to weight ratio. They were most commonly used for parking garages due to their long-span capabilities.

The castellated beams are produced by cutting a saw tooth pattern in the web of rolled steel 'I' section the length of the span. Then the two separated pieces are welded together by joining their tips as shown in the Fig. 1.

The beam section thus fabricated gets increased in its depth by 50% (i.e. 1.5 times) when compared with its original or parent I section. Due to the increased depth, the section modulus of the beam gets increased by approximately 2.25 times that of the original beam section. Thus, the load-carrying capacity of the beam increases considerably.

Castellated beams have been popular in structural applications in recent years due to their excellent strength-to-weight ratio. Nowadays, the beams are used for a variety of applications, such

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# DEVELOPMENT OF INTERACTION SURFACES FOR RCC COLUMNS SUBJECTED TO AXIAL LOAD AND BIAXIAL BENDING REINFORCED WITH FE550 STEEL

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POPAT D. KUMBHAR

## Abstract

RCC elements subjected to axial load and biaxial bending generally come across in design practice; a corner column in an RCC-framed structure is a typical example. Failure of any column subjected to bending, for a particular axial load, can be shown by a failure surface called an interaction surface. This interaction surface is required for designing columns subjected to axial load and bending. An interaction diagram is a vertical section of the interaction surface showing a plot of the axial load a column could carry against its moment capacity. In recent years, higher grades of concrete and steel (Fe550, Fe550D) are being used in many construction projects. With the introduction of such new grades of materials, it has become necessary to develop interaction surfaces and diagrams to meet the design requirements. This paper presents the interaction surfaces developed using ETABS and MATLAB software for RCC columns of different sizes subjected to axial load and biaxial bending considering M20, M25, and M30 concrete grades and Fe415, Fe500, and Fe550 steel grades. Results indicate that for the same column size and concrete grade, the moment-carrying capacity of the column increases by 18.22 % and 29.81 % for Fe500 and Fe550 steels respectively when compared to the column with Fe415 steel. Also, for the same column size and steel grade, the moment-carrying capacity of the column increases by 7.91 % and 13.26 % for M25 and M30 concrete grades respectively when compared to the column with M20 concrete grade. As the developed interaction diagrams are not available in the SP16 code for Fe550 steel, it would be beneficial for designers to verify if the designed column is safe or unsafe.

**Keywords:** Axial load; Biaxial bending; Fe550; Interaction diagrams; Interaction surfaces; Moment carrying capacity; RCC rectangular columns.

## 1. INTRODUCTION

Structural members subjected to axial load and biaxial bending come across commonly in the design process of Reinforced cement concrete (RCC) structures. A typical example of a member subjected to axial load and biaxial bending is the corner column in a framed structure. Analysis of RCC column sections generally deals with the determination of moment carrying capacity for a given value of the axial load or vice versa<sup>[1]</sup>. Since the column is subjected to axial load along with the bending, its capacity becomes a function of both the actions i.e., axial load and biaxial bending moments. Hence, a column section does not have only one value of ultimate load and moment, but a failure surface needs to be determined<sup>[2]</sup>. This failure surface becomes useful in deciding whether the column is safe or unsafe based on the location of a point of intersection of load and bending moment acting on the column section. Thus, when the axial load and bending moment intersection fall inside the failure surface, the column under consideration is said to be safe as per the design guidelines in IS: 456 (2000)<sup>[3]</sup>. This failure surface is formed by plotting axial load vs. bending moments is termed as an interaction surface; whereas, the vertical section of this interaction surface is termed an interaction curve or interaction diagram. A typical interaction curve indicating the points viz. pure axial compression (point A), compression with minor bending (point B), compression control (point C), balanced or critical condition (point D), tension control (point E), pure flexure (point F), pure axial tension (point G) and regions of compression and tension control regions are shown in Figure 1.

The interaction curve shows the relationship between the moment carrying capacity of the column section for varying values of axial loads<sup>[4,5]</sup>. The interaction diagrams (or curves) indicate the combinations of the structural elements' acceptable axial and moment-carrying capacities. The exact design of the column subjected to axial load and biaxial bending is extremely

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## A novel way to designing the undergraduate mechanical engineering curriculum using active stakeholder participation

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**Abstract**— Curriculums that are adaptable to the demands of the communities they serve are the most effective. Whether you intend to modify an existing curriculum or develop one from scratch, you must first undertake an evaluation. This article outlines the creative method utilised to develop the new curriculum in accordance with AICTE requirements. The first stage in formulating a plan is to determine the industries where graduates will find work and the skill sets they will require to be successful in those professions. The strategy emphasizes the need of including important stakeholders in curriculum development at an early stage. According to the findings of a survey given to a diverse group of stakeholders, there are issues with the current curriculum as it is assessed. This paper presents a case study of the development of the mechanical engineering curriculum at Tier-I institution from western Maharashtra for undergraduate (UG) students.

**Keywords**— Curriculum Design; stakeholders' involvement; active participation; Mechanical Engineering.

**JEET Category**— Practice paper

### I. INTRODUCTION

CONCERNS have been raised all over the globe about the market potential of graduates from educational programmes in technical fields like engineering. According to the findings of a study conducted in 2021 on the subject of talent shortages the countries with the most severe talent shortages are Taiwan (88%) and Portugal (85%). Near to 90% of the companies polled in Singapore (84%), china (83) India (83%), said that talent shortages restrict them from recruiting candidates with the required expertise. This issue is pervasive across Asia Pacific. Global average of talent shortage is about 75% [1].

Today's industrial workplace is characterised by a high-performance work ethic, intense competition, a greater emphasis on quality or value addition, a greater range of

products and services, and an increase in automation. The business world demands college grads who are job-ready, meaning they have the necessary skills and are able to immediately begin working on whatever projects or responsibilities have been delegated to them. Not only are technical knowledge and abilities included on the list of anticipated competences for graduates, but also the capacity to collaborate effectively in groups, leadership, interpersonal skills, communication, creative thinking, and flexibility. Due to the shortage of professionally trained people in the industry, businesses will need to invest time, money, and resources into training workers so that they are ready to work. Due to the situation, there must be more contact and collaboration between the different engineering institutes and the industry. Even if a lot of subcomponents of the technical education system require improvement, the curriculum and teaching techniques are the two subcomponents that require immediate attention in order to produce graduates who are industry-ready [3].

A crucial part of every curriculum is ensuring that student learning is directly applicable to real-world contexts. The primary issue with curriculum is that it eventually becomes irrelevant and cannot fulfill external demand. The distractions will make it hard for students to learn. A lack of motivation to learn will slow a student's progress. Not doing so is not in the student's best interest.

To address this issue, the curriculum must be evaluated on a regular basis. The faculty has a unique opportunity to keep track of the curriculum he/she is presenting and give adjustment ideas as he/she goes. Thus, an attempt was made for design and development of UG mechanical engineering curriculum at tier-I institution of western Maharashtra with an innovative approach. Section 2 contains the details about the methodology adopted. Section 3 describes the implementation of proposed methodology and procedure of involvement of various stakeholder in curriculum design & development. Section 4 discusses the result and analysis of feedback survey from stakeholders.

## Inculcating Design Thinking Methodology in the Minds of First Year Engineering Students: A Step Towards Entrepreneurial Thinking

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**Abstract**—Every economy needs entrepreneurs to fill gaps and promote innovative products with the necessary expertise and hard work. An entrepreneurial culture hastens a nation's overall development because it promotes nurturing a greater number of venture capitalists which eventually boosts nation's economy. Rajarambapu Institute of Technology (RIT) Rajaramnagar, an Autonomous Institute has adopted choice-based curriculum system (CBCS) in 2017-18 which included Entrepreneurship development (ED) as one of the four tracks with the objective to transform students into entrepreneurs. It was observed that, there is dire need to initiate entrepreneurial thinking course in first year engineering curriculum to acquaint students with problem solving and creative thinking skills, communication skills and teamwork which are very important for an entrepreneur. Hence, the course 'Creativity, Design Thinking and Entrepreneurial Mindset' was commenced as an open elective for first year engineering students from the academic year 2018-19. In this paper, course details are presented along with course outcomes and In-Semester evaluation (ISE) plan. Design thinking methodology is illustrated phase wise with help of students' project case study. Innovative active learning tools and techniques were developed to map the required skills for an entrepreneur. Due to this strategically developed active learning tools, course CO attainment has improved from the year 2018-19 to 2021-22; CO1 has improved by 37.09 %, CO2 increased by 47.54%, CO3 by 40.30 % and CO4 improved by 28.98 %. Moreover, number of prototypes developed by the students were 4 in the year 2018-19, which elevated to 15 (increased by 275 %) in the year 2021-22. Furthermore, there was improvement in final year ED track students of 2021-22 as compared to 2020-21; 25 students entered ED track during the year 2020-21, out of which 6 students (24 % students) converted their ideas into startups, while during the year 2021-22, 28 students opted for ED track, from which 13 (46.4 % students) established their startups. Lastly, ED track mentors survey results are reported for the year 2020-21 and 2021-22, which clearly illustrate that ED track students' entrepreneurial knowledge and abilities, students' attitude towards entrepreneurship as a career option and students' entrepreneurial self-efficacy has improved than the previous years.

**Keywords**— Design Thinking; Entrepreneurial culture; Startup Ecosystem; Active learning.

### I. INTRODUCTION

Entrepreneurs play a vital role in building nation's economy. They help in solving customers' pain points and thus lead to the development of new product, technology or service which eventually creates an employment. As a result, government place a high priority on promoting entrepreneurial activities because they are correlated with a nation's level of economic growth (Bosma, Hill & Ionescu-Somers, 2020). India, which has the second-highest population in the world and aims to have the third-largest economy by 2030, is making significant efforts to cultivate an entrepreneurial culture in this environment (Hassan, Anwar, Saleem, Islam & Hussain, 2021). However, there are many challenges involved in penetrating this Entrepreneurial culture in the society (Irfan, Rajamallaiah & Ahmad, 2018). The majority of engineering students concentrate primarily on MNC jobs because they believe these positions have a bright future (Lynch, Kamovich, Longva & Steinert, 2021). Therefore, there is a tremendous need to instill an Entrepreneurial culture in students' brains, which will help few of them become successful Startup founders. Rajarambapu Institute of Technology (RIT), Rajaramnagar has implemented choice-based curriculum system (CBCS) since 2017-18. According to this system, final year students can opt for any one choice between Undergraduate research experience (URE), Industry internship and projects (IIP) and Entrepreneurship development (ED) (Suryawanshi, Patil & Kulkarni, 2021). However, it was observed that ED track students are lagging in some prerequisites required for becoming successful startup owners. As a result, we determined which skill sets should be covered in a foundation course during the first year of engineering. Problem solving, creative thinking, communication skills and teamwork are very crucial primary stages of entrepreneurship journey (Jonassen, Strobel & Lee, 2006; Passow & Passow, 2017). Secondly, young entrepreneurs must also comprehend how technology can be successfully commercialized and brought into the market (Barr, Baker, Markham & Kingon, 2009; Bilén, Kisenwether, Rzasas & Wise, 2005). In addition, students have myths about creativity, innovation and feel that creativity is not methodical. Hence there was overall need to develop students' entrepreneurial mindset which gave rise to foundation course entitled

## NAAC Student Satisfaction Survey: A Reliable and Effective Instrument for Institutional Quality Assurance

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**Abstract:** The effectiveness of academic practices and hence student satisfaction in terms of academic engagement is a critical issue for any higher education institute. This work proposes the NAAC student satisfaction survey as a reliable and effective instrument to gauge the academic health of the institute. It demonstrates that the student feedback on the academic practices if analyzed and followed up with appropriate actions, helps improve the student satisfaction index at the institute level and that of departments. The work proposes the hypothesis that the improvement in the student satisfaction index of the institute over four years belongs to concerted efforts and actions taken based on annual survey findings. The hypothesis is tested with the help of ANOVA to validate the findings and conclusion of the work.

**Keywords:** NAAC student satisfaction survey; student satisfaction index; academic health; ANOVA

### I. INTRODUCTION AND LITERATURE REVIEW

Teaching-learning process is at the core of any teaching-intensive higher education institute. The effectiveness of this process directly influence the graduate outcomes in terms of placements, higher learning, research outputs or entrepreneurial efforts. Thus, assessment of teaching-learning process and the need for a metric indicating academic health of the institute becomes evident. Many institutes collect course-specific feedback from the students to gauge the academic effectiveness; however, a general feedback on teaching-learning, irrespective of faculty or the course, is desired to form an overall impression about the institutional academic ambience. Hence, student satisfaction in terms of academic engagement becomes pivotal for any higher education institute.

Earlier works have addressed student satisfaction issue in various contexts like evaluation of a new program or distance learning program, outcomes based pedagogy, effectiveness of vocational program, evaluation framework and some other. Daultani et al. (2021) identified key attributes of student satisfaction in the context of e-learning while Ghansah et al. (2021) investigated student satisfaction determinants for academic and administrative services of a private university. Silva et al. (2020) lends the students satisfaction perspective from Brazil about higher technical-vocational education. Garnjost and Lawter (2019) investigated undergraduate student perceptions across various pedagogies. Gunn (2018) addressed student satisfaction while developing a Teaching Excellence Framework (TEF) for a

university in UK. Skea (2017) presented his arguments on settling and unsettling of student expectations as a part of quality culture of an institute. Gibson (2010) reviewed the attributes which influence the students' perception of overall satisfaction. Möller (2006) presented development of a student satisfaction monitoring instrument at Utrecht University (UU) while Douglas (2006) designed and developed a questionnaire to measure student satisfaction at the faculty of business and law in a university. The abundant literature available also underlines the significance of the aspect of student satisfaction for a higher learning institute. The simplicity and reliability of the instrument used for the assessment of student satisfaction level is a key aspect.

The NAAC (National Assessment and Accreditation Council), a statutory body of UGC (University Grants Commission) is responsible for the institutional assessment and accreditation of higher educational institutes in India. The NAAC as a part of its standard process, uses Student Satisfaction Survey (SSS) - a twenty-one question questionnaire, to evaluate the teaching-learning process of the institute based on the feedback of the students. The NAAC conducts this survey online or through emails as a part of the assessment and accreditation process of the institute and offers five percent weight for the score. Out of twenty-one questions, twenty are objective while one is subjective in nature. These questions cover all the important and relevant dimensions of teaching and learning process like academic planning, course design and delivery, performance evaluation and feedback to the students. The student responses are sought on the five-point rating ranging from 0 to 4, indicating various levels of conformance to the statement. The questionnaire is available at [http://www.naac.gov.in/docs/Apply%20now/SSS-Questionnaire Students.pdf](http://www.naac.gov.in/docs/Apply%20now/SSS-Questionnaire%20Students.pdf) (2021). The student feedback collected offers insights into academic practices and culture; and help gauge the academic ambience of the institute though it doesn't provide feedback on individual course or course teacher. This work makes an effort to demonstrate leveraging NAAC Student Satisfaction Survey questionnaire as a reliable instrument to gauge academic health of an engineering institute and thereby improve the academic experience for its students. The findings are validated statistically with the help of ANOVA. Section 2 presents details about the deployment of the survey by the institute while section 3 presents the key findings based on the analysis of collected feedback. The 'Discussion' section discusses efficacy of this tool for academic health monitoring and further validated with the help of ANOVA in section 5 which is followed by the conclusion section.



# Effectiveness of Jigsaw Strategy on Students Achievement in Engineering Education

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**Abstract**— Outcome-Based Education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). OBE is playing a great role in engineering education, the world over and in traditional educational settings as well as in continuing education. It is a student-centric teaching and learning process in which it deals with the planning, course delivery, and students' assessment to achieve stated outcomes. A number of classroom assessment techniques (CAT) or active learning tools like think-pair-share, flipped classroom, problem based learning (PBL), and cooperative learning techniques such as jigsaw are used for achieving effective learning of the students. The jigsaw technique is one of the active learning techniques which has proved to be an effective method for classroom teaching and hence it is widely used for teaching engineering courses. The present paper focuses on the use of 'jigsaw technique' for teaching the course 'Biology for Engineers', a core course of B. Tech. program, to study students' performance in the End Semester Examination. The course content is difficult to get understood by the engineering students. Therefore, some difficult concept from this course is taught by using jigsaw technique. The students were divided into 8 groups with 8 students in each group. All the groups were assigned a topic with eight different subtopics for study and the jigsaw technique was implemented. The results of study indicated that the use of jigsaw technique improves students' performance by 15% and helps them in developing their lifelong learning skills.

**Keywords**— Cooperative Learning; Experiential Learning; Graduate Attribute; Jigsaw; Outcome Base Education; Student Performance.

**JEET Category**—Research

## I. INTRODUCTION

The Outcome-based education (OBE) is education in which an importance is placed on a clearly articulated idea of what students are expected to know and be able to do, that is, what skills and knowledge they need to have, when they leave the college system. The OBE empowers students to choose what they would like to study and how they would like to study it. Not only does it adapt to a learner's strengths and weaknesses, but it also provides sufficient time to attain proficiency and fluency in the subject matter in Civil

Engineering program. OBE aims to assess the capabilities of learners in their totality. It takes a holistic approach in describing the capability of a learner in terms of knowledge, skills and values, and assessing capability by using a variety of assessment approaches. OBE is a pedagogical model that involves the restructuring of curriculum, pedagogy and assessment practices to reflect the achievement of high-order learning, as opposed to a mere accumulation of course credits. OBE means clearly focusing and organizing everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experience.

Nowadays, OBE and Graduate Attributes (GA) as prescribed by National Board of Accreditation (NBA) plays important role in engineering education in India. Collaborative learning is the educational approach of using groups to enhance learning through working together. Groups of two or more learners work together to solve problems, complete tasks, or learn new concepts. For attainment of GA engineering faculty must use collaborative and cooperative learning tools like jigsaw, flipped classroom, gallery walk technique, problem based learning and project based learning.

In present research paper jigsaw technique was used for Biology for Engineers course which is offered in 6<sup>th</sup> semester of Under Graduate (B. Tech.) program. The course outcome for Biology for Engineers is as given below:

- CO 1: Apply biological engineer's principles, procedure needed to solve real world problem.
- CO 2: Demonstrate the functions of biological systems
- CO 3: Analyze biological phenomena with math and physics to gain important insight.
- CO 4: Explain working of different biological instruments
- CO 5: Select the sensors for given biological applications
- CO 6: Explain relevant aspects of movement control process

This course deals with Circulatory system; Respiratory and Cardiovascular system, Gastrointestinal system; Kidney and excretory system which plays very important role in human body. The content of human body system was taught by using jigsaw technique. After implementation of jigsaw technique

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## Improving of Placements, Higher Studies and Entrepreneurships of Civil Engineering Students through Quality Circle Activity

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**Abstract**—Outcome Based Education (OBE) system is playing a vital role in engineering education as per New Education Policy 2020. In OBE, different types of active learning tools, varying from a simple, class room assessment tools like one-minute paper, think-pair-share, flipped classroom, to a more complex technique like problem based learning, cooperative learning, peer supported independent study are used so that the engineering graduates get equipped with required skill sets to make them industry ready. In India, nowadays the quality of education provided by the institutions and the programs run by these institutions is evaluated by two major bodies namely NBA and NAAC. Accreditation of the programs and institutions by NBA and NAAC is based on some criteria and it has become an essential requirement to ensure the quality technical education. In NBA and NAAC, students' placements, higher education, entrepreneurship, industry internship and connect with industry are considered to be the key indicators for ensuring quality technical education and a higher weightage has been provided in the evaluation process. In this paper, an attempt has been done to improve students' placement index (i.e. placements, higher studies and entrepreneurship) by implementing the concept of Quality Circle (QC) activity for the students of civil engineering department of Rajarambapu Institute of Technology, Rajaramnagar. The results indicate that implementation of QC concept could improve placement index by 10% for last two batches and could maintain progress even during COVID pandemic. Thus, study concludes that implementation of QC concept helps in enhancing placement index of department.

**Keywords**—NAAC; NBA; Outcome Base Education; Placement Index; Quality Circle;

**JEET Category**—Research

### I. INTRODUCTION

The engineering education is an important field for achieving full human potential, developing an equitable and just society, and promoting national development. Universal

high-quality education is the best way forward for developing and maximizing our country's rich talent and resources for the growth of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country. The global education development agenda reflected in the 4<sup>th</sup> sustainable development goal (SDG4) for sustainable development adopted by India in 2015 which seeks to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” by 2030.

The world is undergoing rapid changes in the knowledge background. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, and humanities, will be increasingly in greater demand. The growing emergence of epidemics and pandemics will also call for collaborative research in infectious disease management and development of vaccines and the resultant social issues heightens the need for multidisciplinary learning.

With the quickly changing employment background and global ecosystem, it is becoming increasingly critical that engineering students not only learn, but more importantly learn how to learn. The Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centered, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. All these abilities are possible to be achieved in the presently adopted OBE system. The NBA and NAAC are the two major bodies at the national level which play a great role in evaluating the performance of programs run by

# Hydrogeochemical Evaluation of Groundwater for Drinking and Irrigation Purposes in the Upper Piedmont Area of Haridwar, India

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and Bhavtosh Sharma

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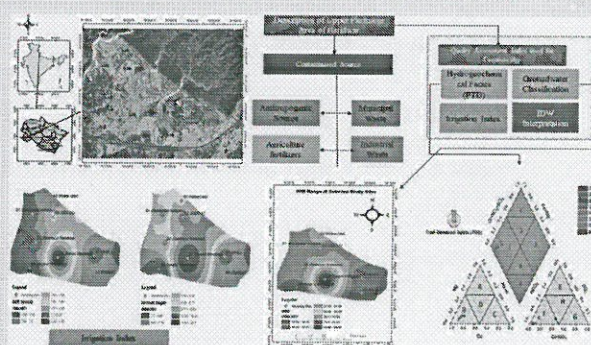
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**ABSTRACT:** In this study, the suitability of groundwater quality for the purpose of drinking and irrigation was evaluated in the upper piedmont area of Haridwar, India. In this regard, inverse distance-weighted interpolation, water quality index (WQI), principal component analysis (PCA), piper trilinear diagram (PTD) analysis, and sodium absorption ratio (SAR) methods were used to assess the geospatial variation of groundwater quality. The results showed that groundwater was partially affected by rapid industrialization and urbanization practices. The groundwater quality revealed the presence of different cations and anions in the following order:  $\text{Ca}^{2+} > \text{Na}^+ > \text{Mg}^{2+} > \text{K}^+$  and  $\text{HCO}_3^- > \text{NO}_3^- > \text{SO}_4^{2-} > \text{Cl}^- > \text{SiO}_2^- > \text{F}^-$ . WQI showed an excellent range (29.94–45.17) for sampling sites S1–S3 and S5–S8 and a good value for site S4 (99.2). In addition, PTD confirmed that the calcium and magnesium bicarbonate type and mixed type for groundwater while PCA revealed that nitrate was dominant at site S4. In addition, the SAR and Na contents were in excellent ranges, indicating their suitability for irrigation purposes. The outcomes of this study indicated that geogenic and anthropogenic processes were the major reasons for the change in groundwater quality in this region.

**KEYWORDS:** groundwater quality, hydrochemical properties, hydrochemical facies, inverse distance-weighted interpretation, principal component analysis



## 1. INTRODUCTION

Water is the most crucial natural resource on Earth and exists in glaciers, surface water, and groundwater.<sup>1–4</sup> Humans utilize forms of water to meet their daily needs; ~43% of agricultural land is irrigated using groundwater globally.<sup>5–7</sup> In the 21st century, groundwater quality is degrading due to natural and anthropogenic factors triggered by rapid industrialization and urbanization. Some natural factors affecting groundwater aquifers are lithological, hydrological, topographical, and climatic.<sup>8–11</sup> In addition, overexploitation, anthropogenic activities such as intensification of the urban and industrial sectors, and agricultural practices affect the hydrochemical properties by enhancing the cation and anion properties and heavy metal contamination.<sup>12–17</sup> Nevertheless, conserving groundwater aquifers is one of the most challenging tasks in preventing a drinking water crisis in the near future.<sup>18–23</sup> Most developed and developing countries are seriously affected by these problems and are working on restoring groundwater aquifers.<sup>24–28</sup> The depletion of groundwater quality via organic and inorganic pollutants will certainly have ill effects on humans, flora, and fauna.<sup>29–32</sup> Some recent studies reported various diseases, namely, hypertension, dental

fluorosis, methemoglobinemia, seizures, epilepsy, neurological disorders, cardiovascular malfunction, kidney disorders, and carcinogenicity.<sup>33–37</sup> Therefore, collecting information related to water quality monitoring, the status of water resources, water types, and contributing factors that degrade quality is essential for management of groundwater aquifers.<sup>38,39</sup> Various techniques for assessing the status of water quality are available, including the water quality index (WQI), which can be used to determine water quality for both drinking and irrigation purposes.<sup>1,16</sup> For the evaluation of groundwater types, the responsible geogenic process that regulates the hydrochemistry can be determined by using the piper trilinear diagram method,<sup>10</sup> Gibbs diagram, cation exchange, Durov

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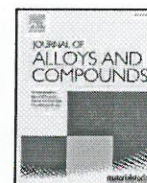
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# Magnetic and structural characterization of Sn doped cobalt ferrites; A visible light-driven photocatalysts for degradation of rhodamine-B and modeling the process by artificial intelligence tools

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## ABSTRACT

Tin (Sn) substituted cobalt ferrites  $\text{Co}_{1-x}\text{Sn}_x\text{Fe}_2\text{O}_4$  with composition ( $x = 0.0, 0.1, 0.2, 0.3, 0.4$  and  $0.5$ ) were synthesized utilizing sol-gel auto combustion method. All synthesized powders were characterized for their structural, magnetic and optical characterization after calcination. The single phase spinel with good crystallisation and a decreasing crystallite size with Sn substitution is confirmed by the powder X-ray diffraction (XRD) pattern. The magnetic measurements were carried out at room temperature where saturation magnetization values show sufficient magnetic nature of calcinated ferrites. The bandgap values for pure cobalt and Sn-substituted cobalt ferrites were closer to the experimental value. The visible light photocatalytic degradation of Rhodamine B was carried out in presence of Sn substituted cobalt ferrites that shows good catalytic activity up to 87% degradation for  $\text{Co}_{0.5}\text{Sn}_{0.5}\text{Fe}_2\text{O}_4$  catalyst. Additionally, this study used Artificial Neural Network (ANN) and Adaptive Neuro-Fuzzy Interface System (ANFIS) models to simulate degradation efficiency with inputs including time, pH, and catalyst dosage. The results revealed that the 3-2-2-1 structure ANN4 model outperformed the other ANN and ANFIS models in the testing phase (RMSE = 6.90% and NSE = 0.92). According to the findings of this study, artificial intelligence models are capable of precisely predicting Rhodamine B degradation.

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## 1. Introduction

Spinel ferrites garnered a lot of attention due to their inexpensive cost, excellent chemical stability, moderate saturation magnetization, high surface area, robust wear resistance, low density, low thermal expansion coefficient, and negligible toxicity to both human health and the environment [1,2]. Due to their distinctive magnetic characteristics and crystalline structure, which are caused by minute variations in the particle size, composition, presence of surface effects, they have attracted researcher's attention in a number of fields [3,4].

The modern era of ceramic research contains the synthesis and study of spinel ferrites with general formula  $\text{M}^{2+}(\text{Fe}^{3+})_2\text{O}_4$  (where

$\text{M}^{2+} = \text{Co, Mg, Zn and Ni}$ ) because of their exceptional chemical and physical properties [5]. Cobalt ferrite a kind of spinel ferrite is gaining popularity because it can be easily modified for use as an adsorbent [6,7]. In order to synthesize ultra-fine ferrite particles, a number of synthetic techniques have been developed, including chemical co-precipitation [8,9], solid state [10], sol-gel [11,12], micro-emulsion [13], hydrothermal [14], cetyl trimethyl ammonium (CTAB) assisted hydrothermal [15], and chemical reduction [16]. As a result, the sol-gel auto combustion method is regarded as a simple, approachable, perfectly composition-controlled, and remarkably reproducible procedure. Low processing time and very low external energy usage are requirements for this method [17]. The material can also be doped with various ions in a range of concentrations to modify its structural [18], optical [19], electrical [20], and magnetic [21] characteristics. Variations in the structure and crystallinity of ferrites are caused by the distribution of various elements between the tetrahedral (A) and octahedral (B) sites. Ferrites nanoparticles

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## Seismic comparison of flat slabs and conventional slabs for structures with irregular shapes

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### Abstract

For a building to perform well during an earthquake, its configuration is crucial. The parameters behave differently in flat slab structures compared to conventional slab structures. A significant factor in the collapse of many high-rise structures is seismic load. Devastation is also caused by structural irregularity, which worsens the effects of earthquakes. This study investigates a comparison between the conventional slab and flat slab buildings considering the effect of structural irregularity on them. The study is carried out for a 14-storey building using response spectrum analysis. The zones considered for analysis are IV and V. The shapes of buildings considered are L-shape, T-shape and Cross-shape. Also, the effect of various parameters like storey displacement, storey shear, storey drift, etc. on the structures has been studied. Results have shown that cross-shape building is having good overall performance with conventional slab system. For flat slab system, T-shape building has performed well.

**Keywords:** conventional slab; flat slab; storey displacement; storey drift; storey shear; structural irregularity

### 1. Introduction

Since the inception of earthquake engineering, earthquake-resistant design of RC buildings has become a highly investigated field [7]. Due to the significant loss of life and property caused by recent earthquakes, it is now necessary to build structures that are earthquake resistant or cause the least amount of damage [9]. The multistoreyed building is becoming a necessary part of our polished and tasteful living with increase in request for space [2]. A high-rise, multi-storey building's seismic assessment is essential for analysing how an earthquake may affect the structure.

When subjected to seismic excitation, the conventional slab system and flat slab system behave differently. Seismic analysis of their behaviour considering parameters like storey displacement, storey drift, storey shear is therefore absolutely required [5]. Unlike the traditional slabs system, which uses beams, the flat slab is a beamless slab with or without drops supported by columns, with or without flare heads. From the slab to the columns and then immediately to the footing, the load is transferred directly [8]. The flat slabs are typically expanded near the columns to increase shear strength and decrease the amount of negative reinforcement in the support region. In malls, theatres, and other buildings that demand broad beams and open spaces, flat slabs are offered. Types of flat slabs: a) Flat slab with drop panel, b) Flat slab with column head, c) Flat slab with drop panel and column head, d) Flat slab without drop panel and column head [3]. When compared to flat slab constructions, conventional slabs have more expensive and complex formwork since the load from the slabs is first transferred to beams and then to columns, increasing the weight of the structure [4].

Punching shear is one of the main issues with flat slab construction. The flat slab connections become a weak link in the entire flat slab structure because of unbalanced moment and vertical shear carried by the slab column connection, that will result in catastrophic damage or even collapse. Buildings with flat slabs frequently experience unbalanced moments, which are brought on by uneven spans or stress on each side of the column. When such situations occur, the

# Effective and Engaging Education and Learning with AI based hologram

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## ABSTRACT

Digital classrooms, virtual distance learning, and other technological advancements have completely changed how students learn in schools and institutions. We can see how digitization is changing education and training as interactive whiteboards in classrooms replace chalkboards and traditional classrooms are replaced with virtual learning environments. Digital technology significantly improves not only the way educators teach, but also the learning experience for students. For an engaging learning experience, cutting-edge technology like AI holograms may bring remote instructors who are subject experts directly into the virtual classroom. The market for digital transformation is expected to expand to \$665 billion by 2023, according to a Markets and Markets analysis on the subject. From 2018 to 2023, the education industry is expected to develop at the fastest CAGR. Digital learning and communication channels are being streamlined and centralised because to the growing usage of digital technology in this industry.

**Keywords:** Holograms, AI, Learning, and Effective Education

## Introduction

The interference of light beams coming from a laser or some other coherent light source is what creates a hologram, which is a three-dimensional image. Because it is not simply a reflection but rather the interference pattern of two beams reflecting an object, it has the appearance of being in three dimensions. One beam of laser light is optically separated into two beams by a beam splitter: the first beam, known as the reference plane, is directed towards the speed of holographic fume travelling through a lens, and the light is expanded so that it completely

## Revolutions of Block Chain Technology in The Field of Cryptocurrencies

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### Abstract

This review paper covers various aspects of blockchain technology and cryptocurrencies. The introduction section provides an overview of blockchain technology and cryptocurrencies, followed by the evolution of blockchain technology. The section on cryptocurrencies covers the different types of cryptocurrencies and the growth of the cryptocurrency market. The section on revolutions of blockchain technology in the field of cryptocurrencies discusses the various innovations that blockchain technology has brought to the financial industry, such as decentralized finance and non-fungible tokens. Additionally, the challenges facing blockchain technology and cryptocurrencies are also discussed, including scalability, security, and regulatory uncertainty. The final section covers the regulation of cryptocurrencies and blockchain technology. The paper highlights the importance of creating a clear and consistent regulatory framework in order to protect consumers and prevent illegal activity, while also fostering innovation and growth in the industry. A comprehensive overview of blockchain technology and cryptocurrencies, highlighting the impact of blockchain technology on the financial industry, the challenges facing the industry, and the importance of regulation. The insights provided in this paper will be of interest to academics, industry professionals, and policymakers who are interested in the development and future of blockchain technology and cryptocurrencies.

**Keywords:** *blockchain technology, cryptocurrencies, evolution, types, revolutions, decentralized finance, scalability, security*

### I. Introduction

Over the past decade, blockchain technology and cryptocurrencies have transformed the way we think about transactions and financial systems. The decentralized nature of blockchain technology has made it a game-changer in many industries, including the field of cryptocurrencies. This review paper seeks to

# Twitter sentiment analysis of lockdown/pandemic in India by using deep learning : case study of COVID-19

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**Abstract:** Internet users today have access to a tremendous amount of data, as well as a massive volume of data has been generated, thanks to the innovation and spread of online technologies. Everyone in the world uses social networks to discuss and expresses ideas on different subjects, take an interest in debates, and exchange news. Sentiment analysis is a technology which mines the opinions from different social media sites and categorize them in the form of positive, negative and neutral polarities. Sentiment analysis is effective for evaluating data in tweets when opinions are unstructured, variable, and either positive or negative, or neutral in some cases. This paper is a literature survey on Twitter sentiment analysis of India/lockdown/lockdown/pandemic keywords. This paper provides a detailed comparative overview of existing opinion mining methodologies, such as Machine learning, dictionary-based approaches, etc. Also are discussed here in common topics and usage of sentiment analysis on Twitter.

**Keywords:** Lockdown, Coronavirus, COVID-19, opinion mining, sentiment analysis, machine learning, deep learning Introduction.

## 1. Introduction

Sentiment Analysis is a method for examining people's feelings, attitudes, and opinions about an item, association, or administration. Opinion investigation is a kind of statistical surveying that utilizes text examination, biometrics, normal language handling (NLP), and computational semantics to decide the condition of information.

It's normal as far as we're concerned to consider about what others think while deciding. Large numbers of us depended on loved ones for item or administration ideas or data before the Internet's appearance. The Internet facilitates our efforts to obtain public opinion. The volume of data generated by users produced every minute is humongous. It is not humanely possible to gather entire data and decipher the meaning conveyed through the same. Effectively, it becomes very much essential to bring automation in classification of evaluations. Such evaluations are labeled as neutral, positive or negative. An example could be part of an email, social media content description, or a blog article. Sentiment analysis is useful to dissect public opinion and extract the understanding of consumer experiences.

There is a huge growth in volume of stream data continuously generated through social media platforms like Face-

book, Twitter, etc. Behavioral science is one of the highly suitable domains providing fresh Twitter content. Twitter is also historically known as a very potent source of data for research of psychology. It's very interesting to analyze how catastrophic events affects sentiments of people e.g. How people react to Coronavirus outbreak and in the subsequent lockdown [1, 2].

It's also observed that researchers have taken keen interest to analyze tweets when different COVID-19 vaccines were made available to public. There are interesting observations at the global, national, and state levels in such incidents. Sentiments are extracted using latent Dirichlet allocation analysis. Temporal analysis is used to look at patterns across time. Geographic analysis, as the name suggests, localities. It deals with contents generated in the form of tweets from different residential areas [3].

Also, Twitter data has been used to investigate human psychology under catastrophic events like COVID-19 pandemic. With the COVID-19, there is huge impact on economy, jobs, social transformations which, to some extent, has resulted into depression and psychological disorders [4]. As psychology of people is reflected in the content generated, feelings of people about lockdown / social distancing enforced by states are a potential area of research [5].

Authors studied multiple data sources in Massachusetts [6] and investigated alterations in polarization of tweets, opined anxiety. It is also composed of discussion on health concerns. This was executed on subset of all tweets chosen stochastically. It can be done using symbolic as well as ML techniques. The prior is time consuming and tedious, scientists' resort to use ML [7].

To elicit feedback from fellow countrymen, Indonesian government has given a lot of emphasis too social network. Analysis of Twitter contents for coronavirus vaccines has proved very effective in their case. Naïve Bayes Algorithm was employed for the exercise [8]. SVM and CRF techniques have been successfully employed by researchers to classify feelings at the sentence level considering emoticons [9] and opinion mining using recommender system.

Extraction of salient topics, themes, and attitudes is done by authors [10] using LDA. They worked upon prominent n-grams and bigrams. Researchers of Typhoon Sandy found



# Novel Approach to Improve Performance of Students in C Programming

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**Abstract:** *C is a primary programming language for computers. C is a fundamental language for successful programmers, from the perspective of a student and a teacher. Because C is the base of all other computer programming languages. Therefore, it is essential to understand every single C programming concept both theoretically and practically. As many students were lagging in programming skills, it is a very challenging task to teach subjects like C programming. While teaching subjects like C programming, we used a variety of innovative activities to increase students' performance in programming. These activities significantly improved the performance of the students. At the end of the semester, it shows a noticeable improvement in the final grade of students by doing a result analysis. Also, course outcome attainment is calculated and analyzed. The use of different activities while teaching C programming leads to improvement in student performance.*

**Keywords:** *C programming, Activity Based Teaching Learning, logical and programming skill, placement.*

## 1. Introduction

C is a general-purpose programming language. C is the basic fundamental language for any programmer. As C is a structural language programmer needs to follow a specific pattern of code while writing a program. So, this may differentiate the C language from other languages and make it beautiful. There is a variety of real-world applications which are developed by using the C language. Google, UNIX OS, Adobe Photoshop, and Mozilla Firefox are some famous applications for the C language. So, from a programmer's point of view knowledge of the C language is very essential. In this paper, we analyze the programming skill of different students and find

out the basic reason behind the lack of skill in programming in students. As per analysis, every student has a different learning style and different level of understanding. Hence, the application of different activities during course delivery may improve the performance of the student and they can understand the concepts easily.


Here, during course delivery of C programming language, following activities are conducted to analyze and improve performance of students.

- A. Online Quiz (Google Form)
- B. Find missing line of codes
- C. Find out error in the code
- D. What will be the output of code?
- E. Online Quiz (Kahoot)
- F. Programming Test
- G. Mock Interview for placement preparation

Initially, an online quiz is conducted for the whole class through google forms to analyze the basic understanding of C programming after completion of the first unit. Also, the performance of the quiz is considered for ISE-I. After that, finding missing lines of code, finding errors in given code, and identifying the output of code without execution are some activities performed among a group of students. Each activity was conducted after the completion of the set of two experiments. At the fourth level of completion of the experiment programming test is conducted and at the end of the course student worked on a mini project by using real-world problems among the group of four students. As the major purpose of this course delivery is to develop a good programmer and focus on placement mock interviews of students are conducted as internal examination by making a panel of three faculty members.

# Textile Production Line Monitoring System Using Wavelet-Regression Neural Network


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## ABSTRACT

This paper presents design and experiments for a production line monitoring system. The system is designed based on an existing production line mapped to the smart grid standards. The discrete wavelet transform (DWT) and regression neural network (RNN) are applied to the operation modes data analysis. DWT used to preprocess the signals to remove noise from the raw signals. The output of DWT energy distribution is given as an input to the GRNN model. The neural network GRNN architecture involves multi-layer structures. Mean absolute percentage error (MAPE) loss has used in the GRNN model, which is used to forecast the time-series data. Current research results can only apply to the single production line, but in the future, it will be used for multiple production lines.

## KEYWORDS

Discrete Wavelet Transform, Frames, Normalization, Power System, Regression Neural Network, Smart Grid

## 1. INTRODUCTION

The paper presents research based on the textile factory production line. For textile manufacturers, the production line's power quality and motor monitoring are essential to operational stability. The purpose of power quality and motor status monitoring is to conduct maintenance in advance to avoid system downtime or malfunctions. New long-distance transmission lines are required to harness these resources to provide an ever-growing load centre. Presumably, these new lines could be high-voltage DC (HVDC) transmission systems owned by companies that break away the standard utilities, which need small and native AC to DC converters. In recent years, many renewable energy sources are wont to generate DC (DC); during this situation, DC to AC inverters must be to interconnect the DC electricity generators to AC systems. Additionally, new power electronics-based controllers like those that the Flexible AC Transmission Systems (FACTS) will install for improving power transfer and providing voltage support are vital factors for reliable operations. Thus, the transmission during a

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# A Literature Survey on Housing Price Prediction

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**Abstract:** Gold, share market and real estate investment are few of the most popular investment types. Specifically, investment into real estate provides handsome returns. Housing price trends is important to both sellers and buyers. However, it also signifies the present economic conditions. Multiple factors affect housing prices, e.g. number of bedrooms, locality, floor number etc. Also, a locality having close vicinity to main roads, academic institutions, malls and jobs cause house price to rise. In this work, I have considered Pune as our case-study location and target to build a model predicting real-time house prices for various localities in and around Pune. I propose to carry out analytical study by considering the dataset that is available through realtor websites viz. 99acres.com, magicbricks.com, nobroker.com. I have used features like 'area', 'bedrooms', 'bathrooms'. In this study, I attempt to create a model that uses regression techniques. Examples are - MLR (OLS), Lasso, and XG Boost. By comparing accuracy provided, the best model is suggested.

**Keywords:** Housing price prediction, OLS, gradient boosting, deep learning.

## 1. Introduction

Machine learning has demonstrated to be effective of solving real-world problems using different algorithms in recent years. It contributes significantly to medical imaging advancements, spam and fraud detection, automotive industry improvements, safety alerts, and business analysis. In this project, I used machine learning techniques to analyse house prices in order to keep abreast of real estate businesses and real estate demand. The most important aspect of any problem analysis is the data. It offers insights in a thorough manner that a person can comprehend.

For most people, purchasing a home is a lifelong dream, but many people make missteps when doing so. Buying overpriced estates that aren't worth; it is a classic error. Prescient models for deciding the selling cost of homes in urban areas like Pune are yet precarious undertakings. The selling cost of land in a city like Pune relies upon a few related factors. The primary factors that can influence the cost incorporate the area of the property, the area of the property, and its size.

In this research work, I have considered Pune as case-study location and target to build a model predicting house prices for various localities in and around Pune. I propose to carry out analytical study by considering the dataset that remains open to the public through realtor websites viz. 99acres.com, magicbricks.com, nobroker.com. I have used parameters like 'area', 'bedrooms', 'bathrooms'.

The dataset has nine features. In this work, I try to prepare a model to forecast the price depending upon the factors

that affect the price. Regression techniques such as multiple linear regression (OLS), Ridge/Lasso, and Extreme Gradient Boost Regression (XG Boost) are useful for the case at hands. The models are pitted against each other and the model with best accuracy is selected by analysing minimum error given by each.

### Data Description -

It will be taken from 99acres.com, nobroker.com and magicbricks.com. Features are as follows:

**Table 1.** Dataset features and description

Area type - describes the area	Total_sqft - measured property size
Availability - when it is ready	Bath - No of bathrooms
Price - value of listing (lakhs)	Balcony - No of balcony
Size - count of bedrooms	Location - of listing in Pune
Society - to which it belongs	

## 2. Literature survey

Manasa and Gupta [1] have taken Bengaluru as city for case study. The property size in square feet, location, and its facilities are all key aspects affecting cost. 9 different attributes are used. The Multiple linear regression (Least Squares), Lasso/Ridge regression, SVM, and XG Boost are used for experimental work. In [2], Luo suggests that to explain the factors that determine residential asset prices, most studies have concentrated on macroeconomic aspects. It looks at some micro characteristics, such as lot size and pool size, that can be utilised as features to estimate house price in this research. Random forest and support vector machine are two machine learning methods which are used to predict asset pricing. R-squared is more than 0.9 in all regression models. Panjali and Vani [3] state that forecasting the resale price of a house on a long-term is vital, especially for those who will be residing there for a considerable duration while selling it again later. It also applies for those who want no risks while the dwelling is being constructed. Authors utilize various classification methods such as Logistic regression, Decision tree, Naive Bayes, and Random Forest to work out the house's resale value. It also applies AdaBoost technique to assist weak learners to be strong ones. The physical characteristics, location, as well as numerous economic aspects persuading at the time decide the resale price of a house. Accuracy is used to measure performance for different datasets and unleash the optimal way for sellers while expecting the resale price. Sawant and Jangid [4] indicate that over the next decade, India's housing market is expected to increase at a rate of 30-35

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# A Novel Method to Classify Rolling Element Bearing Faults Using K-Nearest Neighbor Machine Learning Algorithm

*A novel method is proposed in this work for the classification of fault in the ball bearings. Applications of K-nearest neighbor (KNN) techniques are increasing, which redefines the state-of-the-art technology for defect diagnosis and classification. Vibration characteristics of deep groove ball bearing with different defects are studied in this paper. Experimentation is conducted at different loads and speeds with artificially created defects, and vibration data are processed using kurtosis to find frequency band of interest and amplitude demodulation (Envelope spectrum analysis). Bearing fault amplitudes are extracted from the filtered signal spectrum at bearing characteristic frequency. The decision of fault classification is made using a KNN machine learning classifier by training feature data. The training features are created using characteristics amplitude at different fault and bearing conditions. The results showed that the KNN's accuracies are 100% and 97.3% when applied to two different experimental databases. The quantitative results of the KNN classifier are applied as the guidance for investigating the type of defects of bearing. The KNN Classifier method proved to be an effective method to quantify defects and significantly improve classification efficiency. [DOI: 10.1115/1.4053760]*

**Keywords:** bearing, defects, KNN, features

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# Sine cosine bird swarm algorithm-based deep convolution neural network for reversible medical video watermarking

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## Abstract

Recently, advancements in multimedia have made a huge impact on watermarking technologies. The digital video watermarking is the process of embedding the data in the video. One of the major concerns in digital video watermarking is maintaining the quality of video besides preserving the privacy of the data. The aim of the research is to develop a reversible medical video watermarking using Sine Cosine Bird Swarm Algorithm-based Deep Convolutional Neural Network (SCBSA-based Deep CNN) for embedding the secret message in video frames. The development methodology is explained as follows. The SCBSA is developed by integrating Sine Cosine Algorithm (SCA) with the Bird Swarm Algorithm (BSA). The key frames are extracted from the input video using Minkowski distance and Wavelet distance. The features, like Neighborhood-based features, Convolutional Neural Network (CNN) features, Local Optimal Oriented Pattern (LOOP), and histogram features are obtained from the key frames. The interesting region is identified using DCNN, which is trained using the developed SCBSA. The secret message is embedded in the video in the embedding phase, whereas the embedded secret message is extracted in the extraction phase. The embedding and extracting process are carried out through two level decompositions using wavelet transform and inverse wavelet transform. The developed SCBSA-based Deep CNN uses the metrics, such as correlation coefficient, Mean Square Error and Peak signal-to-noise ratio (PSNR) for evaluating the performance. The developed SCBSA method is evaluated using the Mean

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# A Medical Image Steganography Scheme with High Embedding Capacity to Solve Falling-Off Boundary Problem Using Pixel Value Difference Method

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**Abstract.** Medical images have a vital role in the healthcare industry. The medical sector uses the internet to facilitate the distant sharing of medical information among hospitals and clinics and provide patients with e-health services. We must share a patient's report secretly so that the intruders can't steal the patient's data. The pixel value differencing technique is utilised in this study to store a patient's medical information report in various medical imaging, such as ultrasound images, computed tomography scans, X-rays, magnetic resonance images, electrocardiographs, and microscopic images. The fundamental objective is to maintain the visual appearance of the medical images so that physicians can analyse and give accurate results and extract information reports precisely. This PVD scheme works on different types of image formats such as Portable Network Graphics (PNG), Joint Photographic Experts Group (JPG or JPEG), BitMaP (BMP), and Tag Image File Format (TIFF). Measurement metrics such as embedding capacity, the difference in histograms between the stego and the cover image, and the peak signal-to-noise ratio (PSNR) are employed to evaluate the effectiveness of the suggested method. On a series of medical images, we have tested this new PVD approach and found that it provides significant payload capacity with the high visual quality of the stego image. The majority of PVD techniques described in the literature only apply to grayscale images, and those that apply to RGB images have falling off boundary problem. RGB images have pixel values that span from 0 to 255, but when the pixels are modified using the PVD technique, sometimes these pixel values fall outside of this range, which causes erroneous results to be obtained during extraction. Additionally, utilising a difference in the histograms of the stego and the cover image, the attacker in a typical PVD technique can disclose the existence and length of the secret message. This novel PVD methodology tackles the classic PVD technique's falling-off boundary issue and provides some security to the secret message from the histogram quantisation attack.

**Keywords:** Steganography · PSNR · PVD · RGB · LSB

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## High Embedding Capacity Color Image Steganography Scheme Using Pixel Value Differencing and Addressing the Falling-Off Boundary Problem

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In this paper, we changed the methodology for pixel value differencing. The proposed method work on RGB color images improves the existing PVD technique in terms of embedding capacity and overcomes the issue of falling off boundaries in the traditional PVD technique, and provides security to the secret message from histogram quantization attack. Color images are composed of three different color channels (red, green, and blue), so we cannot apply the traditional pixel value differencing algorithm to them. Due to that, the proposed technique divides the RGB photograph in red, blue, and green channels. Following that the modified pixel value differencing algorithm is employed to all successive pixels of color channels. We get the total embedding capacity by adding the embedding capacities of each color component. After embedding the data, we concatenate the color channels to get the stegoimage. On a series of color images, we tested our pixel value differencing approach and found that the stego-picture's visual excellence and payload capacity were reasonable. The variation in histogram between the stego and cover photographs was minor, making it resistant to histogram quantization attacks, and the suggested approach also solves the issue of falling off the boundary.

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*Keywords:* Steganography; PVD; PSNR; RGB; FOBP; IEP.

### 1. Introduction

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The Internet usage has increased a lot over many years, so one of the major concerns in this digital world is information security while communicating through the internet. There are two main methods for securing data: steganography and cryptography. In cryptography, we encrypt the sensitive information in a meaningless format such that the intruder can't identify it. In steganography, we don't do

# Design and Implementation of Land Area Calculation for Maps Using Mask Region Based Convolutional Neural Networks Deep Neural Network

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**Abstract**—Maps of the land are developed by the surveyor, map developer according to survey of land. In such maps land boundaries are shown using property lines. So the area of land is also mentioned in the maps to the valuation of the property. Area calculation is one of the main work of the surveyor so it is important for him to calculate it fast. So we have implemented a system which can help surveyor, land map developers to calculate the area. We implemented this using image processing and the deep learning model mask region based convolutional neural network (RCNN). For better results, we implemented this at a basic level. At base level synthetic dataset consists of 2 dimensional images of different geometry shapes (triangle, quadrilateral, pentagon, hexagon, octagon) and training our model to detect the shape in the image and based on this further process of area calculation of that shape takes place. This solution is unique for land developers because it uses deep learning and image processing to obtain results.

**Keywords:** mask region based convolutional neural network, deep learning, land area, shape detection, land maps, geometric shapes, area of shapes

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## INTRODUCTION

The “surveyor” and “topographer” are both major factors of a land surveyor. The role of a land surveyor is to go to the place and analyze the place, take details and identify the configuration of the place and after that have to do some geometric calculation and then have to develop maps to use this information for land and property developments. In the world of technology still, some sectors have not accepted technology completely. Still, in the modern world, land surveyors draw land maps using scale, pencil, and using other instruments on paper. Also in our country, old land maps are drawn already on paper. So in case of any issue like plotting of land, boundary declaration, NA (non-agricultural) plotting, division of property, and others like that, you have to go to the city survey office of town and do the process from the surveyor officer. This office contains land maps of all town regions in paper format. So in case of the above issue, he has to check manually your land’s map and do the process. In this case, for calculating the area of land he has to go to the location and take measurements and again draw new maps. In some cases, there is confusion about areas in old maps due to paper becoming too old and it may be damaged. So surveyor officers

need to cross-check and find the area of land or property. There are various existing methods for such work. Some surveyors use various mobile applications which show the location of land, area of specific land using a GPS. Also, use the application for finding online documents of the land. But in case of drastic change in the geolocation of fields, such applications are not much effective for getting a value of the boundary points or you can say the coordinates of the edges. Assume there is a new road plan created and for this road, some land of the people is used and these people will get a refund for the land from the government. In such a case surveyors have to draw new maps for the part of the land used in the road. So the surveyor has to draw himself a new map, no GPS application is helpful for him. because GPS gives works on existing geolocation but in the above situation surveyor has to assume and draw a map according to plan.

For land surveyors and the property map developers’ area calculation system will be helpful because the system helps in calculating the area of land from maps of the land. The new learner can use this at the learning phase to cross-check the area given by the system and the area calculated by the user manually of the same shape. At the base level, we are trying to detect the shape in the image and calculate the area of that shape. In advance to such system, we are trying to get area from just scanning the image from computer’s camera. That is, the user has to just scan this map

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# Comparative Study of Lane Detection Algorithms

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**Abstract:** This review paper presents a comparative study of various lane detection algorithms used in Advanced Driver Assistance System (ADAS) of Vehicle. Lane detection systems are key parameters in the ADAS which helps to go for autonomous or adaptable ability of vehicle. Presently there were various methods for lane detection used with their own capabilities but at certain circumstances, such algorithms are failing shortfall in the different parameters. Hence, the acceptance ratio for such lane detection algorithms are less. So, there is a need to develop a hybrid algorithm which will improve the accuracy and give success in all decided parameters. In the recent technology, there is vast development in deep learning using artificial intelligence. So we are focusing to develop a hybrid algorithm which consists of deep learning along with artificial intelligence and machine learning. In this paper, we have focused literature survey of recent developed mechanism algorithms for lane detection.

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**Keywords:** ADAS, Lane detection, Image Processing, CNN

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## Introduction

Advanced Driver Assistance System formerly known as ADAS is one of the highly used features in car industry now a days. It helps to enhance, adapt and automate the driving exposure and abilities of a vehicle. Also, we have seen that mobility has become a key social and economic factor as it is the backbone of commercial trading and services. For the same, ADAS helps mobility to explore its key aspects. Lane detection System is the key factor of ADAS in which lane on the roads are detected and used as characteristic feature for various applications like lane Keep Assist, lane departure, autonomous driving, etc. The ability to take effective decisions is crucial factor and hence lane detection should be done as faster as real-time to avoid any causalities on the road as well as proper implementation of ADAS. There are various ways for lane detection like using cameras and video processing for lane detection or using LIDAR sensors. Also, there are algorithms which modifies for each user with their own capabilities and advantages. We have referred research papers from last decade and reviewed

## Smart Monitoring Unit for E-bicycle

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### Abstract:

With an improvement in Technology and raise of sensors, there have been attempts to utilize the new technology in various areas to improve the quality of human life. One main area of research that has seen an adaption of technology is the automotive sector. The main objective of work is for monitoring and controlling of electric bicycle parameters. It comprised of three main parts. The part being, detection of vehicle parameters using sensors, second for generating IP address and the last part is providing the android app. This data enables the user to monitor parameters like temperature, speed in rpm, detection of obstacles within the range set and controlling the movement of the vehicle by using android app. The Internets of Things (IoT) concepts have been widely used to interconnect the automobiles and offer smart, reliable and effective controlling and monitoring of the vehicle. The proposed system collects the sensor data through ESP32 microcontroller and then processes and analyses for viewing. Based on the analyses, vehicle parameters can be monitored and controlled using the android app.

**Keywords: E-bicycle, IoT, monitoring,**

### Introduction

Over the years, advances in technology have enhanced our lives. Currently, a majority of nations are embracing electric bicycles. Cycling is always more eco-friendly than driving a car, but the most significant endorsement of green transportation in recent years has been electric bicycles. Instead of a regular bicycle, consider an electric-powered scooter as an alternative to petrol-operated scooters. An E-bicycle is powered by rechargeable batteries and can reach speeds of 25 to 45 kmph. Consequently, it will get you to your destination swifter and in better condition than a regular bicycle.

### II. Background and Related work

Electric bicycles, often known as an e-bike, are motorized bicycles with built-in electric motors that help with propulsion. Now there are many different types of e-bicycles out there, but they may be divided into two main groups: peddles, which help

## Edge Computing With Software Defined Network for Enhancement in Interoperation of Heterogeneous Internet of Things

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**Abstract:** *Internet of Things (IoT), a near future world which will become key factor in everyone's daily life. With ubiquitous growth of Internet of Things, various IoT platforms and protocols are required to interconnect a huge number of IoT devices. Such network structure introduces heterogeneity and this high heterogeneity between such different IoT platforms and protocols decreases interoperability among IoT devices. So design and implementation of software defined networks (SDN) with this scenario is required to cope up this situation. IoT with SDN framework handles bi-directional communication and thus allows interoperation among various IoT devices supporting different application-layer network protocols. Large numbers of different sensors and heterogeneous devices are the terminals in IoT. To control infrastructure of smart word, terminals in IoT continuously generates data and exchanges messages through complex network supporting machine-to-machine communications. A technique to provide local computing for the issues as resource congestion in IoT, edge computing (EC) a new paradigm has emerged. As compared to cloud computing, a network referred as 'edge' placed near to the terminals in IoT and relocate data computation or storage to the edge network. Definitely computational overhead of centralized network is now reduces due to distributed nodes present in edge network. Also latency in message exchange is decreases which is major requirement of real time IoT applications, thus response will be fast compared cloud services. As computation and communication overhead of limited battery power node is transfer to nodes with significant power resources, increases individual nodes life. Different comprehensive surveys prove that edge computing improves the performance of IoT in terms of network latency, bandwidth occupation, energy consumption, and overhead. Researchers provide novel platforms in edge computing for heterogeneous IoT and proved with considering case study of application in IoT. In this paper, we conduct survey on such different platforms and compare performance based on results.*

**Keywords:** *Heterogeneous IoT, Software Defined Network, Edge Computing, Smart Healthcare system.*

### I. INTRODUCTION

A decade ago, one notion has announced as Internet of Things which includes our daily lives physical objects like wireless sensors, smart phones, RFID. It can be described as digitally connected universe of everyday physical devices. These devices are intelligent and are embedded with internet connectivity, sensors and other hardware that allow communication and control via web [1]. The concept was a ubiquitous future network where everything including live objects can be attainable, sensed, and interconnected inside the global, dynamic structure of the Internet.

As Internet of Things encompasses every physical object, it is required to interconnect more-capacity and full-functional traditional computers as well as small-size and constrained devices. It is necessary that every physical object is able to communicate with each other regardless of features that it having and therefore research work is focused on the design and implementation of IoT standards and platforms, to attain machine-to-machine communication between all types of IoT devices. In every network architecture, use of appropriate communication methods by smart devices is helpful for integration of digital information and physical objects, which offer users with new exciting applications and services. Even if moving ahead to develop robust Heterogeneous IoT applications, heterogeneous network configuration, different communication technologies and complexity of application impose many challenges for researchers.

With rising edge of Internet of Things, requires interconnection of stack of IoT devices and for that purpose, numerous IoT platforms and protocols are suggested. Thus heterogeneity in IoT enhances, and high heterogeneity between IoT standards lowers the interoperability in IoT devices. As different approaches are introduces for enhancement in interoperation of heterogeneous IoT, this paper includes work done by different researchers in HetIoT field.

For heterogeneous IoT, to enhance interoperation between various devices, recently software defined network (SDN) concept has been used. SDN confer a new networking design that focuses to centralize the network control and to separate the data and the control planes. Thus, gives benefit from SDN to extract the major management complexities present in this ubiquitous network of networks i. e. IoT [2]. IoT network structure based on SDN provides centralization of the network control with decentralization of the data management

## Effective Conduction of Laboratory Courses in Online Learning using Virtual Lab

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### Abstract—

In the Covid 19 pandemic, education shifted from offline to online, impacting a lot of technical education. The online theory courses were conducted effectively, but there were a lot of problems the faculty faced in conducting laboratory courses. This problem includes an ineffective demonstration of lab experiments, difficulty in time management, monitoring, and assessment, inability to tackle the issues of various students' learning styles, and unavailability of a common platform for online lab conduction. In technical education, the lab course plays a vital role. We found that a virtual laboratory is the best solution to address these issues. Many virtual labs are available for programming courses but need a customized Virtual lab for core courses. In this paper, we have carried out 16 surveys through Google forms to get inputs/feedback from faculties and students to get difficulties in online lab conduction and how we can make the best use of virtual labs online to conduct the lab experiment online mode. We designed and created the virtual laboratory for the Computer Networks Lab course with various learning materials, including theory, simulation videos, pre-test & post-test, and the procedure to conduct the lab experiment, which benefited the students. The implemented virtual lab found more effective. We found the significant impact on the result of CN Lab after using the customized virtual lab for CN Lab course.

**Keywords—** Virtual Lab, Learning Style, Effective online engagement, Student Learning, Online Monitoring, Assessment, Time Management, Cross platform, CodeIgniter, Responsive web page, Wireshark, Cisco Packet tracer

### I. INTRODUCTION

The COVID-19 epidemic showed the shortcomings of conventional teaching strategies. By taking into account the skill set that must be instilled in the students, teaching in the online form has grown to be a significant problem for faculty. Due to their inability to attend both the theory lectures and the labs, the students were severely impacted. Manca, F., & Meluzzi, F. (2020), academic institutions made the decision to switch the teaching and learning process from offline the online form. The online lectures were delivered using different active teaching-learning methods and tools through the platforms like MS Teams, Zoom, etc., but it was a big challenge to conduct the lab session for the students in online mode.

Due to the COVID-19 epidemic, most classroom instructions were transferred off-campus, and students were allowed to complete their coursework from home via the

internet. To retain their high academic standards, educational institutions took the necessary steps to shift their instruction, particularly laboratory courses, into an online or blended mode of delivery. In higher education, laboratory experimentation was crucial. That made the laboratory instruction conduction challenging across the higher education environment. Students had not received face-to-face instruction, and access to lab resources had been restricted or nearly impossible. Due to their inability to use the lab's facilities or actually conduct the experiments there, students suffered significantly. There were several issues, such as poor internet connection, low bandwidth, student engagement, lack of ICT resources etc., while conducting the laboratory classes online. As there was not a convenient platform accessible, effective delivery was impossible. The current online teaching modality was unable to monitor, record, and evaluate students' performance. Answering questions about lab experiments in online mode proved challenging. As there was not a convenient platform accessible, effective delivery was impossible. The current online teaching modality was unable to monitor, record, and evaluate students' performance. Answering questions about lab experiments in online mode proved challenging. These situations lacked the ability to conduct lab experiments using concepts, simulations, prerequisites, demo experiments, pre-post evaluations, and the ability to determine whether or not the lab experiments were carried out by students.

The success of the science learning process was supported by a number of favorable effects of the growth of digital-era technology. Information technology could be utilized in place of interactive laboratories in schools to meet their demands. A virtual laboratory was one effect of the development of the digital era that could be applied to the field of education. R. Md Zahidur (2014), the virtual lab offered fun lab processing and simulation features, tool simplicity, and more precise results.

A virtual lab was a teaching tool that enabled more effective experimentation, interactive virtual environments, and direct experimental visualization.

According to Scheckler, R. K. (2003) & Tatli, Z., & Ayas, A. (2013), students could individually expand their understanding by repeating the incorrect experiment as part of the virtual lab exercise.

In actuality, virtual labs offered a number of advantages in reaching the desired learning objectives. The utilization of virtual laboratories solved some of the issues that arise in

# Imparting effective Teaching Learning Methods for teaching C programming course to First Year Non-IT Students

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**Abstract**— Nowadays, Computers are the dominant technology of the twenty-first century. Thus, programming and the development of software are fundamental activities in which many people across the globe are involved. As a result, programming courses are part of the curriculum. The course is introduced to all first-year IT and Non-IT students who have either no or less expertise in computer programming. The main purpose to select these techniques for non-IT students is to prepare them to work with IT specialists at their future jobs by instilling in them a constant knowledge of technical fundamentals. But as compared to IT students, learning of C programming becomes difficult for non-IT students due to this their passing rate is low. Students lose their interest in programming due to their having less computer programming knowledge which leads to a gap in technical competency require by the IT sector. Taking this into consideration activities like quizzes, debugging tests, and usage of a virtual lab for students were implemented. These activities enhanced students' way of thinking, problem-solving ability, programming, and debugging skills. The idea of using PBL teaching methods, Think-Pair-Share, and E-Learning may improve the effect of C language teaching, and promote the student's learning initiative. The main focus of this study is to enlighten different teaching approaches and methodologies for first-year non-IT students.

**Keywords**— Coding standard, E-Learning, Programming Language, PBL Teaching, Problem-solving, Non-IT, Virtual Lab.

## I. INTRODUCTION

Information technology has recently advanced quickly and has become quite important to modern living. This function is crucial both at home and at work or school. Students must therefore master a variety of computing abilities to feel confident, be prepared for the future, and be able to contribute effectively to the IT world.

According to ERUM MEHMOOD (2020), the programming course is introduced to all first-year students who have either no or less expertise in computer programming. The programming is challenging for novices right away. First, there are some language issues. Any programming language has a syntax that is extremely dissimilar from a normal language. Simple grammatical mistakes might produce cryptic

error messages that are challenging to deciphering. Additionally, the students run into semantic challenges.

It is challenging to forecast the precise outcome of a programmed code because it is difficult to accurately understand the operational semantics of programming language features. In consequence, this makes writing programs challenging. Second, solving problems is challenging regardless of the complexity of the programming language used. For beginners, language difficulty matters more than problem-solving.

For undergraduate students to apply their newly acquired knowledge to real-world situations rather than just writing code, they must possess problem-solving abilities as per Vidya S. Handur (2015). They ought to be able to create and enhance a system using quantitative and qualitative evaluations of its performance, functionality, and usability. They should be aware that there are various answers to a certain issue and that choosing one of them is not merely a technical task because these solutions will affect people's lives. Graduates should also be able to explain their solution to others, including the rationale behind it, the steps it takes to resolve the issue, and any presumptions that were made.

The most effective approach to learning is activity-based learning. The teacher facilitates the learning of the students through a variety of activities. The independence of the learner is prioritized above everything else, which produces the optimal learning environment. The information and materials required to help the students concentrate and think critically are made available to them. Activity-based learning can be implemented using a variety of activities, depending on the teacher's skills, the student's abilities, the time available, etc. Teachers can employ many types of exercises to make their lessons entertaining, which is helpful.

Therefore, the primary goal of modern computer education for students who do not major in IT is to prepare them to always be knowledgeable about technological foundations and be able to communicate effectively with IT specialists at their future workplaces. This paper focused on, how to combine PBL and E-Learning to teach the fundamentals of programming to non-



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Department of Management Studies (MBA)



**3.1.3 Details of teachers awarded National/International fellowship for advanced studies/ research during the year**

Name of the Author(s)	Department of the Author(s)	Title of the Paper	Name of the Journal	Month and Year of publication	ISSN
Mr. Shakil M. Mulla Dr. Seema S. Desai	MBA	A Study On Impulsive Buying Behavior Of Youth Towards Online Buying	The Journal of Maharaja Sayajirao University of Baroda	July 2022	ISSN 0025-0422
Sudarshan D. Jadhav	MBA	A Study On Awareness Of College Students About Cryptocurrency With The Special Reference To Islampur City, Sangli District	Journal of the Oriental Institute	Oct-22	ISSN: 0030-5324
Dr. Seema S. Desai	MBA	Problems Faced By Physically Challenged Children Towards Their Complicated Life.	The Journal of Maharaja Sayajirao University of Baroda	Jul-22	56 No.1(V) 2022



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The Maharaja Sayajirao University of Baroda

## Certificate of Publication

Certificate of publication for the article titled:

**A STUDY ON IMPULSIVE BUYING BEHAVIOR OF YOUTH TOWARDS  
ONLINE BUYING**

Authored by

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Assistant Professor

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# Journal

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### A STUDY ON AWARENESS OF COLLEGE STUDENTS ABOUT CRYPTOCURRENCY WITH THE SPECIAL REFERENCE TO ISLAMPUR CITY, SANGLI DISTRICT

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**Abstract:** Technology made many changes in payment system. Students are more familiar with technology. After the bitcoin boom in India, mostly young generation are attracted toward the cryptocurrency. Cryptocurrency is decentralized and it is based on blockchain technology. Bitcoin, Ethereum, Cardano, Dogecoin, Litecoin, Bitcoin Cash, and Potcoin are more popular cryptocurrencies in India. As per report majority investor are between age 18 to 24 years. This study mainly focuses on awareness of colleges students about cryptocurrency. This study also focuses on various factor affected on awareness of cryptocurrency. For this study, we are collected 120 students' responses. Sample are selected on the basis of non-probability snow ball sampling method. The finding of this study is, mostly respondents are aware through friends and social media about the cryptocurrency. And male respondents are more aware than female respondents. Higher level educational qualification also impacts on the high-level awareness about cryptocurrency. Majority respondents are interested to invest in cryptocurrency.

**Keywords:** Cryptocurrency, Bitcoin, Blockchain Technology, Awareness, Investment

#### I. INTRODUCTION

In India, more than 20 million people invest their money in cryptocurrency. The major age investor belongs to the 18-24 categories. Technology changes rapidly and its impact is made on growing digital payment. Due to blockchain technology digital payment is more secure. Cryptocurrency is based on blockchain technology and it is decentralized. Due to the cryptocurrency boom in India, the young generation is attracted to cryptocurrencies. According to the report by industry research firm 2021, the cryptocurrency market growth is increased by 641%. In Indian, there is the highest rate (30%) on income earned from the digital currency. This is the impact on the investor of the cryptocurrency. According to the study, the relation between cryptocurrency ownership and age is vice versa. It means that, if you get older crypto is not more attractive. Cryptocurrency is attractive to the young generation. So, the first purpose of the study is, To Study the college students' awareness and perception of cryptocurrency.

In India, many brokers or platforms are available that provide an easy way to exchange or Buy/Sell cryptocurrency. Following are some popular cryptocurrency exchange platforms in India. Paxful, Zebpay, CoinSwitchKuber, Binance, Unocoin, Coin DCX. All the cryptocurrency platform help to





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**PROBLEMS FACED BY PHYSICALLY CHALLENGED CHILDREN  
TOWARDS THEIR COMPLICATED LIFE**

Authored by

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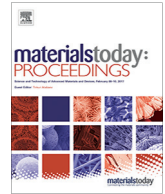
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# A review on surface coating techniques on Mg based bio-degradable implants

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Orthopaedic

## ABSTRACT

Cobalt-chromium alloys, Stainless steel and alloys of titanium are the traditional implant materials used in orthopaedic applications. However, these implants induce stress shielding effect and release harmful ions in the human body. Also, on the completion of bone healing, these must be removed by performing additional surgery. Magnesium (Mg), being biocompatible and biodegradable, can be a potential replacement for these traditional implants. But, Mg is having low corrosion resistance in the physiological environment. Surface coating proves to be an elixir to ameliorate the corrosion resistance of Mg. Biocompatibility and biodegradability are the paramount requirements of the coating material. Therefore, Hydroxyapatite (HA) is preferential material for coating. This review is intended to study the microstructure, characteristics and degradation behaviour of HA-coats deposited on Mg-based implants by electrochemical methods. The beneficiaries of this study will have a guideline for selecting particular compatible process and parameters to maximise the performance of implants.

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## 1. Introduction

Magnesium (Mg), being biodegradable and biocompatible, can be a promising candidate to replace traditional implant materials. It has the natural ability to degrade when placed within a physiological environment. The degradation of Mg in the physiological environment releases  $Mg^{2+}$  ions, which cause no harm to the human body. Thus the requirement of additional surgery is eliminated. But the degradation of Mg in physiological environment is rapid. Therefore the Mg-based implant may lose its integrity before accomplishment of the bone healing process. Therefore, improvement in corrosion performance of these biodegradable alloys is strongly needed. One of the valuable methods is a surface coating to slow down the corrosion rate of Mg alloys. These coats will not act as perfect inhibitors for corrosion but will decelerate the implant's initial corrosion rate. Along with implants, coatings will also degrade in the body gradually. The HA coating and its

degraded product are non-toxic, biocompatible and biodegradable [1]. Hence, HA is extensively used for coating the Mg-alloyed substrate. This review is mainly intended to understand the degradation behaviour of HA coated Mg-based implants where the HA is deposited by various electrochemical methods.

## 2. Mg as orthopaedic biomaterial

In Comparison with traditional implants, the yield strength, modulus of elasticity, as well as the density of Mg-alloys are lower and nearer to human bone. This closeness of Mg's properties with natural bone, limits the stress shielding effect, which is commonly observed in the traditional implant. Table 1 illustrates that Mg's mechanical properties are closer to the bone. The prime biological functions such as enzymatic reactions, normal heart rhythm, muscle contraction, synthesis of protein, DNA and RNA involve Mg [2]. In the human body, Mg is available mainly in teeth and bones. It has a vital role in remodelling of bone. The  $Mg^{2+}$  ions augment the process of bone healing by encouraging deposition of calcium. Almost no shreds of evidence that highlight the ill-effects of Mg are

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# Inculcating Design Thinking Methodology in the Minds of First Year Engineering Students: A Step Towards Entrepreneurial Thinking

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**Abstract**—Every economy needs entrepreneurs to fill gaps and promote innovative products with the necessary expertise and hard work. An entrepreneurial culture hastens a nation's overall development because it promotes nurturing a greater number of venture capitalists which eventually boosts nation's economy. Rajarambapu Institute of Technology (RIT) Rajaramnagar, an Autonomous Institute has adopted choice-based curriculum system (CBCS) in 2017-18 which included Entrepreneurship development (ED) as one of the four tracks with the objective to transform students into entrepreneurs. It was observed that, there is dire need to initiate entrepreneurial thinking course in first year engineering curriculum to acquaint students with problem solving and creative thinking skills, communication skills and teamwork which are very important for an entrepreneur. Hence, the course 'Creativity, Design Thinking and Entrepreneurial Mindset' was commenced as an open elective for first year engineering students from the academic year 2018-19. In this paper, course details are presented along with course outcomes and In-Semester evaluation (ISE) plan. Design thinking methodology is illustrated phase wise with help of students' project case study. Innovative active learning tools and techniques were developed to map the required skills for an entrepreneur. Due to this strategically developed active learning tools, course CO attainment has improved from the year 2018-19 to 2021-22; CO1 has improved by 37.09 %, CO2 increased by 47.54%, CO3 by 40.30 % and CO4 improved by 28.98 %. Moreover, number of prototypes developed by the students were 4 in the year 2018-19, which elevated to 15 (increased by 275 %) in the year 2021-22. Furthermore, there was improvement in final year ED track students of 2021-22 as compared to 2020-21; 25 students entered ED track during the year 2020-21, out of which 6 students (24 % students) converted their ideas into startups, while during the year 2021-22, 28 students opted for ED track, from which 13 (46.4 % students) established their startups. Lastly, ED track mentors survey results are reported for the year 2020-21 and 2021-22, which clearly illustrate that ED track students' entrepreneurial knowledge and abilities, students' attitude towards entrepreneurship as a career option and students' entrepreneurial self-efficacy has improved than the previous years.

**Keywords**— Design Thinking; Entrepreneurial culture; Startup Ecosystem; Active learning.

## I. INTRODUCTION

Entrepreneurs play a vital role in building nation's economy. They help in solving customers' pain points and thus lead to the development of new product, technology or service which eventually creates an employment. As a result, government place a high priority on promoting entrepreneurial activities because they are correlated with a nation's level of economic growth (Bosma, Hill & Ionescu-Somers, 2020). India, which has the second-highest population in the world and aims to have the third-largest economy by 2030, is making significant efforts to cultivate an entrepreneurial culture in this environment (Hassan, Anwar, Saleem, Islam & Hussain, 2021). However, there are many challenges involved in penetrating this Entrepreneurial culture in the society (Irfan, Rajamallaiah & Ahmad, 2018). The majority of engineering students concentrate primarily on MNC jobs because they believe these positions have a bright future (Lynch, Kamovich, Longva & Steinert, 2021). Therefore, there is a tremendous need to instill an Entrepreneurial culture in students' brains, which will help few of them become successful Startup founders. Rajarambapu Institute of Technology (RIT), Rajaramnagar has implemented choice-based curriculum system (CBCS) since 2017-18. According to this system, final year students can opt for any one choice between Undergraduate research experience (URE), Industry internship and projects (IIP) and Entrepreneurship development (ED) (Suryawanshi, Patil & Kulkarni, 2021). However, it was observed that ED track students are lagging in some prerequisites required for becoming successful startup owners. As a result, we determined which skill sets should be covered in a foundation course during the first year of engineering. Problem solving, creative thinking, communication skills and teamwork are very crucial primary stages of entrepreneurship journey (Jonassen, Strobel & Lee, 2006; Passow & Passow, 2017). Secondly, young entrepreneurs must also comprehend how technology can be successfully commercialized and brought into the market (Barr, Baker, Markham & Kingon, 2009; Bilén, Kisenwether, Rzasas & Wise, 2005). In addition, students have myths about creativity, innovation and feel that creativity is not methodical. Hence there was overall need to develop students' entrepreneurial mindset which gave rise to foundation course entitled

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## PAPER

# Assessment of surface integrity and hole quality in graphene-based NMQL Micro-drilling of ceramic-coated Nimonic 90 for gas turbine applications

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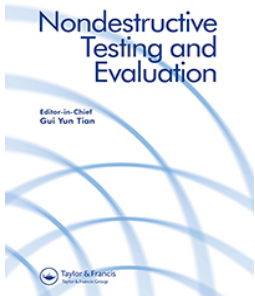
**Keywords:** micro-drill, nimonic 90 superalloy, gas turbine, biodegradable, acid oil, thermal barrier coated, graphene nanofluid

## Abstract

Nickel-based superalloys have superior strength properties at higher temperature ranges and thus have become increasingly important in manufacturing gas turbine components for aerospace industry. However, the desire for a larger thrust-weight ratio has raised the typical operating temperature in a gas turbine; thus, thermal barrier coatings are essential. The present work compares the micro-drilling performance of ceramic-coated Nimonic 90 nickel superalloy under dry, flood and 0.5% graphene-based NMQL conditions. The biodegradable acid oil was used as a base oil, and the assessment comprised surface integrity in terms of surface roughness inside the hole and micro-crack formation and hole quality based on the diametrical overcut and taper ratio. Spindle speed (1000, 2000 and 3000 rpm) and feed rate (3, 6, and 9  $\mu\text{m}/\text{rev}$ ) were changed in three levels, and Taguchi L9 array was applied for the design and analysis of the experiments. Ti-Al-N coated tungsten carbide drill of diameter 700  $\mu\text{m}$  was used, and Analysis of variance (ANOVA) revealed that spindle speed was the utmost important parameter impacting surface roughness, while speed and feed rate both influenced overcut and taper ratio. 0.5% Graphene-based NMQL lubrication condition significantly diminished the surface roughness by 52.67%, overcut by 46.86% and the taper ratio by 48.87% as compared to dry condition. Furthermore, in the NMQL condition, micro-crack development and ceramic layer damage were minimized, resulting in better surface integrity. In addition, burr development was minimized at the hole periphery, and tool wandering was not seen in the NMQL condition. Hence the hole quality was superior in NMQL conditions as compared to the dry and flood lubrication.

## 1. Introduction

Superalloys exhibit excellent mechanical properties at elevated temperatures. They have superior creep properties, making them sustainable for a prolonged time at a temperature near their melting point [1]. In addition, superalloys have high oxidation and corrosion resistance, making them possible candidates for specific applications [2, 3]. There are various types of superalloys like Iron-based, Cobalt-based or Nickel-based. However, Nickel-based superalloys possess high strength at elevated temperatures. They thus are widely preferred in the manufacturing of aero-engine (gas turbine) components such as combustor cans, afterburners, casing, turbine blades etc [4–6]. Nickel superalloys account for more than 40% of the weight of an aero-engine [7]. The thrust-weight ratio of an aero-engine is directly proportional to the inlet temperature of a turbine [8]. However, high temperature increases the stresses and oxidation which decreases the service life of the engine components [9]. Hence thermal barrier coatings (TBCs) are extensively used to prevent the engine components from high heat, and thus thrust-weight ratio can be maintained [10]. TBCs generally consist of a base material on which the bond coat is applied, and a ceramic layer is sprayed, generally 150–200  $\mu\text{m}$ , which has low thermal conductivity [11]. In addition, closely spaced micro holes are required to be drilled on engine components which



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## Empirical-based DA and ANN to diagnose misalignment in rotor-bearing system

Ganesh L. Suryawanshi, Sachin K. Patil & Ramchandra G. Desavale

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# An Attempt to Enhance the Visualization, Imagination and Drawing Skill of Freshman Engineering Students through Problem Based Learning Approach

Sachin N. Sawant, Pankaj S. Ghatage, Sachin K. Patil

**Abstract**— The Engineering Drawing is one of the important and compulsory course for all the engineering students in first year engineering. This course improves the visualization, imagination and drawing skill of the students which are helpful them to draw their ideas clearly and rapidly, to read the drawing drawn by others and to create successful design. Engineering Drawing course includes projection, section and development of solids in which students are expected to imagine, visualize and develop the drawing as per given conditions also it includes orthographic projections in which 3D objects are required to convert in 2D drawing. The students of first year engineering find this task difficult due to no prior basic knowledge of technical drawing, poor imagination and visualization skill. Hence the attainment of the course learning outcome related to these topics is recorded low. To overcome this problem, a problem based learning approach implemented along with classroom teaching in order to enhance the, visualization, imagination and technical drawing skill of first year engineering students. In this article, the author has presented the efforts taken to improve the visualization, imagination and drawing skill through active engagement of students for learning in the classroom and outside of classroom. Due to systematic implementation of problem based learning (PBL), student's engagement towards learning, attainment of the course outcomes (COs) and overall exam result of the course have been improved.

**Keywords**— Course Learning Outcome, Engineering Graphics, Engineering Drawing, Problem Based Learning

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## I. INTRODUCTION

Engineering drawing is a universal technical language of an Engineers which is globally accepted technical language to communicate between engineering professionals. Based on Engineering drawing skill Engineers can able to create designs, represents them on drawing sheet and finally prepare blue print before the manufacturing (Murthy et al., 2015). The ability to understand important topics in engineering drawing such as orthographic projection, isometric drawing, hidden views, and sectional views are very critical as it represents the fundamentals of engineering drawing education (Serdar and De

Vries ,2020). Engineering drawing is the compulsory course in first year engineering class to improve the drawing and imagination skill of the students, however due to lack of prior basic knowledge of technical drawing, poor imagination skill of the students and time restrictions in the classroom teaching, it is challenging for the faculty members to train the students for good drawing skill with conventional teaching methodology. Hence many faculty members implemented innovative teaching methodologies. Murthy et al. (2015) implemented Augmented Reality (AR) as a tool for teaching Engineering Drawing and improved 3D visualization of the students. Chen et al. (2011) developed tangible and AR models for Engineering Drawing course to increase the learning interest of students and to improve the visualization of the students. Pucha and Utschig (2012) implemented learning-centered strategies like case studies and real-world problems for freshman engineering students while teaching Engineering Drawing course. Authors have presented the impact of the learning-centered strategies on students learning, engagement and performance. Soundattikar and Naik (2016) conducted case study while teaching Total Quality Management course. They found that case study is effective tool for engaging students with different learning styles. Perumaal (2018) created effective learning environment for the course Engineering graphics through different active learning activities to improve the spatial visualization of students. Govil (2021) introduced sketching as an iterative tool in engineering education to improve visual communication skill of the students. Shreeshail et al. (2021) implemented problem-based learning technique to impart engineering drawing standards. Zemke (2018) discussed case study on efforts taken to teach Engineering Graphics for blind students. The author has presented the progress of blind students while learning orthographic and isometric projections. Moyano et al. (2009) presented the case study on Engineering Graphics learning, author evaluated the prior knowledge and background of the freshman engineering students. Author concluded that the rate of students' cognitive development does not follow the efforts taken by faculty member during teaching learning process, hence new suitable methodology could be developed to improve the cognitive abilities of the students. Potter and

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## Original Article

# Effect of copper, tungsten copper and tungsten carbide tools on micro-electric discharge drilling of Ti–6Al–4V alloy



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## ABSTRACT

Achieving microholes with dimensionally higher accuracy on the Ti–6Al–4V alloy using traditional machining techniques is challenging. Micro-electric discharge drilling (μEDD) has become a prominent machining technique in fabricating microholes. Though there are extensive applications of μEDD in producing microholes in difficult-to-cut materials, the appropriate tool materials and process parameters determine the process characteristics and accuracy. Because of the uneven machining and inadequate debris flushing, the technique is less productive and results in high overcut (OC) and hole taper (HT) for the microholes as well as poor material removal rate (MRR). Additionally, the rate of electrode wear affects hole precision. To address these issues, a rotating tool electrode set-up was used to drill microholes in Ti–6Al–4V alloy. The impact of three distinct electrode materials, copper (Cu), tungsten copper (WCu), and tungsten carbide (WC), as well as various process parameters, was investigated. The μEDD was accomplished by changing input process parameters, viz. voltage (V), capacitance (C) and tool rotation speed (TRS) and using Cu, WCu and WC tool electrodes to examine their influence on the process response variables such as MRR, TWR, OC, and HT. The experiments for each electrode were designed using a Taguchi-based L9 array, and the results were examined using Analysis of Variance (ANOVA). Capacitance was found to be the most significant electrical parameter in the μEDD of the titanium alloy. At 10,000 pF capacitance, the WCu electrode showed the highest MRR 0.009247 mm<sup>3</sup>/min, which was 6.11% and 21.92% higher than the Cu and WC electrodes. In contrast, the WCu electrode had the lowest tool wear rate (TWR) of 0.002033 mm<sup>3</sup>/min, which was 280.61% and 61.61% less than the Cu and WC electrodes, respectively. The WC electrode exhibited more accuracy by reducing the OC and HT compared to the Cu and WCu electrodes. The Cu tool electrode owing to its lower melting point and high thermal conductivity ensued in higher TWR than the WCu and WC

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# Circular supply chain implementation performance measurement framework: a comparative case analysis

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## ABSTRACT

Circular supply chain (CSC) has gained traction amongst academicians, practitioners, and policymakers across the world due to its wide range of sustainable benefits to business organizations. CSC amalgamates the circular economy (CE) thinking into supply chain operations of industry and improves the three sustainability dimensions of the organizational performance. However, manufacturing organizations in developing economies are finding difficult to measure the impact of CSC adoption on organizational performance. Therefore, this research aims to explore the CSC performance measures and to develop a performance measurement framework for assessing the impact of CSC implementation on business organizational performance. This research proposes a modified balanced scorecard (BSC) based hybrid framework of Pythagorean fuzzy analytic hierarchy process (PF-AHP) and Pythagorean fuzzy weighted aggregated sum product assessment (PF-WASPAS) methods. The effectiveness of the proposed framework is validated through an empirical case study of an Indian manufacturing company. Further, the proposed framework is tested with other three Indian manufacturing companies and their results are compared with the case company. The finding reveals that the overall performance of empirical case company is 62.88% based on define set of performance measures and performance of other three companies are 64.51, 56.47, and 52.43%, respectively. The outcomes of this study shows that the proposed research framework is more reliable, consistent, and robust with circular perspectives and it also offers an effective way to measure and benchmark the impact of CSC adoption on organizational performance. This research contributes to the knowledge of CSC management for achieving sustainability in the business environment.

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Circular economy; circular supply chain; performance measures; modified BSC; PF-AHP; PF-WASPAS

## 1. Introduction

In the present dynamic and cutthroat business environment, each manufacturing organizations want to have their production network more feasible towards three elements of sustainability (Abbasi et al. 2022; Lahane, Kant, and Shankar 2020). Many of the business organizations across the globe are facing the various issues of unsustainability, such as climate change, global warming, waste generations, resource paucity, and environmental deprivation (Das, Konietzko, and Bocken 2022; Bressanelli et al. 2021). Thus, to deal with these issues and threats of unsustainability, organizations need to adopt innovative and sustainable initiatives into their supply chain practice. Lately, the term circular supply chain (CSC) has received much more interest from academicians, practitioners, and managers of a business organization (Lahane and Kant 2022b; Bag et al. 2022). CSC acts as a one of the most effective and sustainable strategies for the waste management in a manufacturing organization. CSC assimilates the circular economy (CE) principles into supply chain operations. It is considered as an alternative approach to linear

economic model (i.e. extract-produce-use-dump), where products are dumped into landfill after end-of-use phase (de Souza et al. 2022; Batista et al. 2018; Jain, Jain, and Metri 2018).

CSC maintains the materials, products, components in circular loop as long as possible till the maximum value can be obtained from it (Angelis, Howard, and Miemczyk 2018). CSC focuses on the CE 6Rs principles. CSC network is design based on recuperative aspects of CE (Bressanelli et al. 2021). CSC emphasizes on value gain aspects of CE (Pinheiro et al. 2022; Mhatre et al. 2021). It also deals with the triple bottom line concept of sustainability (Goyal, Chauhan, and Mishra 2021). The businesses organizations can attain numerous benefits, such as reduces emissions, reduce resource scarcity issues, improves competitiveness, reduces energy usage, improves end-of-life strategy, improves product design, improves material and resource efficiency, improves social and economic efficiency, improves sustainability and productivity, etc. by adopting CE in supply chain of an industries (Farooque et al. 2022; Mhatre et al. 2021; Farooque et al.



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# Vibration Analysis of Deep Groove Ball Bearing Using Finite Element Analysis and Dimension Analysis

*Condition monitoring of rotor dynamic is recognized as an advanced preventative maintenance technique for fault-free operation. Faulty bearings in rotating machines may cause severe problems and even untimely breakdowns. This work demonstrates the power of the finite element analysis (FEA) model and dimension analysis technique (DAT) to analyze the effect of the depth and slope angle of surface faults on the bearing contact characteristic. Experimentation is performed to investigate the vibration characteristics of ball bearings. The FEA, DAT, and experimentation show that vibration amplitude is a vital function of surface fault size. The current approach of FEA with DAT reflects their reliability and accuracy for the diagnosis of rotor systems. The present method was found effective in predicting vibration amplitude and defect frequency within acceptable error.*

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**Keywords:** vibration, fault diagnosis, finite element analysis (FEA), dimension analysis technique (DAT), rolling element bearings

## 1 Introduction

Rolling element bearings, like a ball, cylindrical, or conical rolling bearing, are majorly used in power generation industries, process industries, machine tools, and automobiles. The rolling bearing is repeatedly invoked as antifriction bearings. When preferred and appropriately tested, they can operate effectively over a lengthy duration of time. Due to fatigue behavior, the life span of a rolling element bearing is definite. Ball bearings implicate a point association between the races and the balls, which produces high stress at the contact. Failure of bearings causes malfunctioning of the machinery and shut down, which impacts the final product's price and quality. It is estimated that 30% of the machinery faults are attributed to antifriction bearings. Therefore, condition monitoring of the bearings in rotating machinery is crucial. A new regulating instrument for the shift from reactive to proactive is condition-based monitoring in industries. Premature failures can be identified and analyzed with the help of conditional monitoring, which reduces downtime and costs.

Different fault diagnosis techniques are developed and utilized efficiently to forecast imminent machine failures at their current stage. Some include vibration analysis, oil debris analysis, non-destructive testing, thermal, noise, and motor current analysis. It is among the most common methods for analyzing vibration. By analyzing vibration signatures, one can predict the condition of the rotor-bearing systems in rotating machinery using experimentation or model-based techniques. The model-based technique can convert complex engineering problems into simplified mathematical models. The model-based theoretical approach builds the circumstances for the effectiveness of experiments and evaluation of mathematical models with experimental results. Therefore, the model-based vibration conditioning monitoring techniques have been to pick up in-depth study throughout the earlier decades. Using dimensional analysis and signal processing techniques makes it feasible to attain significant characteristic frequency

from the vibration signals. The present work uses the innovative technique of model-based study to determine the effect of speed, load, surface defects size, and other physical parameters on bearing failure.

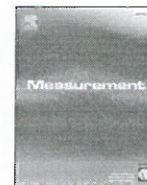
Trevor and Farshid [1] investigated crack induction and spall evolution in the rolling element employing a finite element model subject to rolling contact fatigue. This model uses the continuum deterioration method to seize the induction and reproduction of fatigue fracture, which eventually shows the creation of a surface spall. Wang et al. [2] proposed tacho-less order tracing technique centered on order spectrogram conception. The ridge eradication method is needed to assess the spontaneous frequency of a revolving harmonic. The order spectrogram is constructed, and rotating speed fluctuation is suppressed by non-stationary interference. With this technique, fault orders are disclosed, and the type of bearing fault is determined.

Neisi et al. [3] illustrated a simulated model to examine the stresses of touch-down with a crack bearing. The finite element analysis (FEA) is used to model the rotor, and friction contacts are determined between touch-down bearing and rotor. Hertzian contact stresses of rolling elements and stress intensity factors for crack initiation are studied, showing an increment in dynamic friction coefficient and air gap growth upsurges Hertzian contact stresses. Mishra et al. [4] studied a simulation model for ball bearing with a higher degree of complexity. The bearing kinetics based on the motion model in MATLAB deprived of traction and contact dynamics with bond graph also considered spatial multi-body model using ADAMS software. Shi et al. [5] suggested an FEA model elaborating the influences of fracture on contact characteristics in the bearing. The dynamic model with crack is investigated for bearing vibration.

Bonneau and Absi [6] presented a numerical technique for grooves in journal bearings. Reynolds equations are determined using the finite element (FE) approach and Newton-Raphson for nonlinearity discretized equations. Narrow-groove theory (NGT) is analyzed with the smooth bearings with various configurations. Bonneau et al. [7] developed the Reynolds equation for gas thrust bearing and grooved gas face seal established on the FE. Integration by parts reduces the complexity of uneven thickness, and the upwind technique is used for solving oscillating solutions. Iseli et al. [8] analyzed dynamic characteristics of spiral grooved gas

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# Fault identification in a nonlinear rotating system using Dimensional Analysis (DA) and central composite rotatable design (CCRD)

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## ABSTRACT

This paper investigates the effect of bearing clearance and external defects on the vibrational behavior of rolling element bearing. An integrated nonlinear model is developed using the Buckingham pi theorem to detect imminent bearing faults. Vibration responses acquainted experimentally by varying speed, clearance, and external defect on the rotor-bearing system are processed using fast Fourier techniques (FFT). Result analysis reveals the dominance of clearance and external defects on the dynamic stability of the rotor-bearing system. The maximum vibration amplitude among the all trials performed was 2.201 mm/sec at 1300 rpm shaft speed, 75 gm unbalance mass, and 0.025 mm bearing clearance. A close agreement of experimentation with model prediction assures accuracy and reliability. Central composite rotatable design (CCRD) shows its effectiveness in performing the design of experiments with understanding procedures. The current approach highlight's fault identification and interactions with less than 9% error that satisfy the demands of current condition monitoring or diagnosis of industrial rotor-bearing systems.

## 1. Introduction

The rotating component's dynamic properties mainly determine the performance of rotary equipment with rolling element bearings. In regular operation, rolling bearings typically have local flaws, radial clearance, and Hertzian contact, which result in load distribution, fatigue life, and vibrational issues. Bearing failure is the most common cause of rotary machinery failure, which necessitates continuous status monitoring to priorities complicated dynamics, thereby avoiding costly damage and production loss. As a result, researchers have concentrated their efforts on diagnosis and continuous monitoring. As a result, the current study focuses on identifying and classifying clearance levels and local abnormalities. Identification and classification of faults and precise calculation of clearance level are all part of effective condition monitoring, which leads to cost-effective and appropriate corrective procedures.

Gupta et al. employs FEM to model the nonlinearity effects of the flexible rotor-bearing system. Investigation for nonlinear dynamic

response with clearance on unbalanced flexible rotor braced by a deep groove ball bearing is carried out [1]. In rotor bearing system the nonlinearity is produced due to combined effect of radial clearance and unbalance [2]. Lavanya et al. studied heterogeneous faults in IoT based Wireless Sensor Networks and implemented a novel energy-efficient heterogeneous fault management technique (IWSN). The proposed scheme employs three distinct diagnostic methods to efficiently identify heterogeneous faults. Classifying heterogeneous faults is made easier by the Tuned Support Vector Machine classifier, which uses the Hierarchy-based Grasshopper Optimization Algorithm to optimise tuning parameters. [3]. Prasanth implemented Underwater Wireless Sensor Networks (UWSN) with relatively better network survivability, the Energy-efficient Fault detection and Recovery Management (EFRM) approach was proposed. To achieve effective fault detection across the entire network, the Hidden Poisson Markov model has been integrated into EFRM [4]. This work uses the K-nearest neighbour in tandem to investigate multiple faults in a rotor-bearing system. The proposed methods produce promising results in predicting and classifying multi-fault with

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# Dynamic Characterization of MR Fluid-Based Dynamic Vibration Absorber

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## Abstract

A magnetorheological (MR) damper is effective and economical for miscellaneous applications in automotive, mechanical, civil, and relative fields. A parameter tuning methodology independent of manual trial-and-error has received much technical interest for controlling vibrations. The present work contributes mathematical and Simulink modeling followed by MR damper design and development for vibration optimization of the single degree of freedom system. A Simulink model of an MR damper is performed on the mathematical model for vibration control, and the MR damper's tuning parameters are experimentally investigated to control the resonance frequency. Theoretical simulated results and its experimental verification show that increasing current raises the force to control the resonance frequency in an MR damper. The present approach provides a concise and improved platform for dynamic vibration absorber in the current potential market and the highly interested control community for the development of the distinctive attributes of the MR Damper.

**Keywords** MR damper · Vibration control · Modeling and simulation · Dynamic vibration absorber

## List of Symbols

$A$	Parameter to determine the hysteresis loop in the Bouc–Wen model (dimensionless)
$c_0$	Viscous damping at large velocities, Ns/m
$c_1$	Dashpot used to introduce the nonlinear roll-off observed at low velocities, Ns/m
$c_2$	Damper of the secondary system, Ns/m

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$C_{0b}$	Constant that determines $C_0$ , Ns/m
$C_{1a}$	Constant that determines $C_1$ , Ns/m
$C_{1b}$	Constant that determines $C_{1b}$ , Ns/mV
$F$	Frequency of external force, Hz
$F_d$	Force of damper, N
$F_o$	Amplitude of exciting force due to eccentricity, N
$e$	Radial eccentricity of its cam, m
$K_o$	Preload stiffness, N/m
$K_1$	Primary (supporting) system stiffness, N/m
$K_2$	Secondary (absorber) system stiffness, N/m
$K_3$	Accumulator stiffness, N/m
$m$	Mass of eccentricity, kg
$m_1$	Primary mass, kg
$m_2$	Secondary (absorber) mass, kg
$z, \dot{z}$	Variable to depict the history dependence of applied response, Hz
$X$	Displacement of the damper piston, m
$\dot{y}$	Velocity of the damper piston, m/s
$N$	Wen model (dimensionless)
$x_0$	Initial displacement of spring $k_1$ associated with nominal damper force to accumulator, m
$x_1, x_2$	Displacement of $m_1$ and $m_2$ , m
$\ddot{x}_1, \ddot{x}_2$	Acceleration of $m_1$ and $m_2$ , m/s <sup>2</sup>
$A$	Scaling value for Bouc–Wen model, N/m
$\alpha_a$	Constant that determines $\alpha$ , N/m





# A multi fault classification in a rotor-bearing system using machine learning approach

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## Abstract

Modern condition monitoring of rotating machinery became intelligent for enhanced reliability, productivity, and safety. Signal processing has been collaboratively implemented with several machine learning approaches to increase the effectiveness of the fault diagnosis. This paper explores fundamental bearing frequencies withdrawn from a vibration response as novel extracted features. Experimentally obtained vibration data at diverse operating conditions have been analyzed and supplied to a supervised machine learning algorithm K nearest neighbor network (KNN) for fault classification. The result shows that the KNN algorithm based on the novel features provides 98.5% fault classification accuracy and feels promising for condition monitoring of industrial rotating machines.

**Keywords** Fault diagnosis · KNN · Bearing characteristics feature · Signal processing

## Abbreviations

KNN	K-nearest neighbor
ANN	Artificial neural network
SVM	Support vector machine
LSTM	Least squares support vector machine
EMD	Empirical mode decomposition characteristics
REB	Rolling element bearing
MS	Mild steel
CNN	Convolutional neural network
GANs	Generative adversarial nets
WT	Wavelet transform

SIRCNN	Stacked inverted residual convolution neural network
HT	Hilbert transform
IMF	Intrinsic mode functions
DA	Dimensional analysis

## 1 Introduction

Extensively increasing automation has increased the complexity of the modern industrial system and raised the standards for precision. This has increased demand for modern, efficiently run mechanical equipment. Thus, health monitoring of complicated machinery is thus an essential but costly endeavour. Rolling element bearings (REBs) are an integral component of widely used industrial equipment and determines the equipment's service life. Over the lifespan, the equipment loses its durability and performance, and failure risk increases simultaneously. The condition-based maintenance scheme should be an integral part of any preventative maintenance plan [1]. Excessive vibration is the most common reason for a system failure, and the most common source of vibration is fault present. Local and widespread defects in the machine may lead to catastrophic failure. Bearing failure in any of the heavy rotating machines or assembly lines can result in a shutdown, affecting the overall cost and quality of the product. Recently, substantial research has been conducted on defect classification without disrupting

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# A Novel Incipient Fault Detection Technique for Roller Bearing Using Deep Independent Component Analysis and Variational Modal Decomposition

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*Roller bearing failure can result in downtime or the entire outage of rotating machinery. As a result, a timely incipient bearing defect must be diagnosed to ensure optimal process operation. Modern condition monitoring necessitates the use of deep independent component analysis (DICA) to diagnose incipient bearing failure. This paper presents a deep independent component analysis method based on variational modal decomposition (VMD-ICA) to diagnose incipient bearing defect. On a newly established test setup for rotor bearings, fast Fourier techniques are used to extract the vibration responses of bearings that have been artificially damaged using electro-chemical machining. VMD techniques diminish the noise of the measurement data, to decompose data processed into multiple sub-datasets for extracting incipient defect characteristics. The simplicity of the VMD-ICA model enriched the precision of diagnosis correlated to the experimental results with weak fault characteristic signal and noise interference. Moreover, deep VMD-ICA has additionally demonstrated strong performance in comparison to experimental results and is useful for monitoring the condition of industrial machinery. [DOI: 10.1115/1.4056899]*

*Keywords:* rolling bearing, incipient defect, vibration analysis, deep independent component analysis, rolling element bearings

## 1 Introduction

Rolling element bearings, like a ball, cylindrical, or conical rolling bearing, are majorly used in power generation industries, process industries, machine tools, and automobiles. The rolling bearing is repeatedly invoked as anti-friction bearing. When preferred and appropriately tested, they can operate effectively over a lengthy duration of time. A rolling element bearing's average life-span is known because of fatigue behavior. Ball bearings implicate a point association betwixt the races and the balls, which produces high stress at the contact. Failure of bearings causes deficient of the machines and abandon, which impacts the final product's price and quality. Anti-friction bearings are believed to be responsible for 30% of machinery failures. As a result, bearing condition monitoring in rotating machinery is extremely crucial. A new regulating instrument for the shift from reactive to proactive is condition-based monitoring in industries. Premature failures can be identified and analyzed with the help of conditional monitoring, which reduces downtime and costs.

Different fault diagnosis techniques are developed and utilized efficiently to forecast imminent machine failures at their current stage. Some include vibration analysis, oil debris analysis, non-destructive testing, thermal, noise, motor current analysis, component error, oil flowrate, oil viscosity, and statistical features. It is among the most common methods for analyzing vibration. Using experimentation or model-based techniques, one can forecast the health status of bearings in rotating machinery's by analyzing vibration signatures. The model-based technique can convert complex

engineering problems into simplified mathematical models. The model-based theoretical approach builds the circumstances for the effectiveness of experiments and evaluation of mathematical models with experimental results. Therefore, the model-based vibration conditioning monitoring techniques have been to pick up in-depth study throughout the earlier decades. Using signal processing techniques makes it feasible to attain significant characteristic frequency from the vibration signals. The present work uses the innovative technique of model-based study to determine the effect of speed, load, surface defects size, and other physical parameters on bearing failure.

Stefatos and Hamza [1] developed Tennessee Eastman challenge technique by independent component analysis (ICA)-based methodology to identify the primary source of the fault. Fan and Wang [2] proposed kernel-dynamic independent component analysis for fault identification. Plotting of non-linear contribution with Tennessee Eastman process showed greater effectiveness. Mao et al. [3] developed deep transfer learning with a pre-trained VGG 16 model for fault identification in auxiliary bearing. Deep features with fine-tuning technique are used for training model with support vector machine.

Cai et al. [4] developed noisy independent component analysis for condition monitoring. Fourth order cumulant matrix with joint diagonalization is estimated by noisy intercluster separation algorithm. Three variable system with stirred tank reactor system detects fault by recursive independent component kurtosis. Cai and Tian [5] investigated robust independent component analysis (Robust ICA) algorithm for extracting non-Gaussian features for robust whitening and determination. Cai et al. [6] developed a model for milling chatter with energy entropy and variational mode decomposition (VMD). Number of modes with quadratic penalty is an input function to VMD for kurtosis selection with total energy absorbed by frequency band. Simulation and

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## Crack Detection in A Cantilever Beam Using Correlation Model and Machine Learning Approach

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*Abstract:* - Crack in a structural member alters local stiffness that affects the dynamic response, such as natural frequency and mode shapes. The purpose of structural health monitoring is to diagnose and predict structural health. In this paper, a correlation model is developed to detect crack parameters, i.e., crack location and crack depth, in the beam. To evaluate the authenticity of the developed correlation model, the Artificial Intelligence-based approach is used to predict the crack parameters. Twenty-three Artificial Intelligence algorithms were used to predict the locations and depths of the crack in a cantilever beam. The developed correlation model used the first two normalized natural frequencies to predict the crack parameters. On the other hand, the first three normalized natural frequencies were used to input the machine learning models to predict the crack parameters. In this research study, V-shaped and U-shaped open edges cracks were considered on the cantilever beam. FEA software, ANSYS, is used to do the modal vibration analysis of various cracked cases of beams. The data set of V-shaped and a U-shaped cracked case obtained from finite element analysis (FEA) were used to develop the correlation model and machine learning models. The results for crack locations and crack depth obtained from the correlation model and machine learning models agree with the actual results. In the future, the proposed correlation model of crack detection can be used to detect cracks in more complicated structures.

*Keywords:* - Correlation model, ANN, Machine learning, Natural frequency, FEA and Crack location.

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### 1. INTRODUCTION

Beams are used in various structural applications in the automotive, civil, and aerospace industries. The presence of crack affects the structure's stiffness and affects the mechanical response of the whole structure to a more considerable extent. Due to these changes, there is a reduction in modal frequencies and mode

shapes. Therefore, it is feasible to anticipate the crack characteristics by determining changes in the vibration parameters [1].

A fault diagnosis method based on genetic algorithms (GAs), and a model of damaged (cracked) structure is proposed. For modeling the cracked-beam structure an analytical model of a cracked cantilever beam is utilized, and natural frequencies were

## Experimental and Numerical Investigation of a Cracked Cantilever Beam for Damping Factor to Access its Applicability in the Crack Detection

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### Abstract

The cracks alter the physical and modal properties of the beam, i.e., stiffness, damping, natural frequency, and mode shapes, and, in turn, the dynamic response of the beam changes to a considerable extent. The condition monitoring of the beams is essential to avoid its catastrophic failure in applications. A basic criterion has been followed for modal parameters like natural frequencies, mode shapes, and stiffness for the possible crack detection. In contrast, damping as a dynamic property to represent structural damage has been limited due to the difficulties in measuring damping and analysis. Therefore, in this study, the effect of various possible crack profiles, i.e., V-shaped and U-shaped, on the applicability of using the damping criterion for determining the presence of damage in the cantilever structure was investigated. The damping loss factor for all the cracked cases of a cantilever beam was computed using ANSYS and experimental analysis. The numerical results of the damping loss factor were compared with experimental results. It was understood that the results were susceptible to the crack geometries changes.

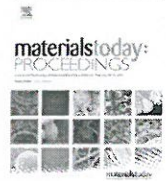
**Author Keywords.** Effective Mass, Dewesoft FRF, Impact Hammer, V-shaped Crack, U-shaped Crack, Structural Health Monitoring, ANSYS, Torsional Stiffness, Resonant Amplitude.

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### 1. Introduction

A structural health monitoring system is generally designed to monitor, inspect and test the health and performance of structures such as beams, buildings, bridges, and dams, to ensure their safety. It mainly consists of two major components: the smart sensing technologies and the damage detection algorithms. The smart sensing technologies use fiber optic sensors, piezoelectric sensors, laser Doppler vibrometers, and accelerometers to monitor various



# Design and development of automotive radiator for better cooling efficiency

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## ABSTRACT

Today's Automobiles are getting equipped with high powered engines. Out of total energy produced by combustion nearly 30–35% is generally used for cooling engine hot water. In such engines, heat dissipation is observed to be improper due to many reasons which cause overheating of the engine, which further leads to damage to lubricating oil film, engine parts and also wear and tear between engine parts. This excess heat can be removed with the help of the effective use of cooling water. The present work aims to identify different ways that need to be used for improving the cooling efficiency of the radiator. LMTD and NTU methods are used for the design of the heat exchanger. The cross-flow heat exchanger is completely designed for the augmentation of heat transferred from the radiator. Different tube arrangements and fin materials are used in this work which gave the effective solution to the problem stated above. The newly developed cross-flow heat exchanger is used in automobile vehicle radiators on a stationary engine in the laboratory which has further helped for reducing the fuel consumption and increasing heat transfer. The comparison is also made for cooling efficiency from the newly fabricated cross-flow heat exchanger with the previous one. The major outcome of the research work is a reduction in fuel consumption by 8.78% with the use of a designed heat exchanger and an increase in brake thermal efficiency by 23.16%. It is also seen that with the change in the tube arrangement, tube shape and fin material, the heat transfer rate is also improved by 24.37% for various dynamometer loading conditions.

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## 1. Introduction

The primary role of any heat exchanger is to transfer thermal energy from a relatively hot fluid to a cold fluid. The heat exchanger is widely found in applications in refrigeration, air conditioning, heating, energy generation and chemical processing industries. A Crossflow heat exchanger is widely used in a car as a radiator. In the heat exchanger, heat transfer occurs between hot water present in the heat exchanger and the flow of air circulating in an orthogonal direction to each other, so that hot flow and cold flow cross each other. A Crossflow heat exchanger provides a larger contact surface area. This paper is focused on redesigning the cross-flow heat exchanger by changing tube arrangement and fin material [1]. Arasu et al. [15] studied the thermal behaviour

of an automobile radiator. LMTD and NTU methods are used for design and performance analysis. Brave et al. [4] illustrated the design of the fan and analyse it for its strength in the structure using the Finite Element Method and the flow of air in all directions by using the Computational Fluid Dynamics approach.

Bozorgan et al. [9] in their article, used copper oxide water Nanofluid as a coolant in a radiator of a Chevrolet Suburban IC engine with given heat exchange and pumping power for CuO-water capacity. Trivedi et al. (2012) [7] illustrated the effect of tube pitch for a best-configured radiator for optimum presentation. Ibrahim et al. [2] explained the effect of using nanofluids on heat transfer performance in heat exchangers. Shah and Gururaja Rao [3] described various techniques for heat transfer enhancement from electronic devices.

Different research papers on the design and optimization of cross-flow heat exchangers [10,5,6,11,13] were referred to and observed that there is scope to work on and arrangement of tubes, the material of fins. With this gap, it is decided to use different

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## A Case Study on Course Outcome & Program Outcome Mapping Levels Based on Competency & Performance Indicators.

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**Abstract**— This Paper gives an insight into an essential part of practicing outcome-based education (OBE). One of the crucial parts of OBE is measuring the quality and quantity of Program learning skills that student has acquired through various assessments. Course Outcome attainment heads up the learning in a specific course. However, the Program Outcome (PO) attainment needs the relation of Course Outcome & Program Outcome (CO-PO), i.e., mapping levels for calculations. The author has demonstrated the CO-PO mapping level underpinning the competency and Performance Indicators. The methodology for CO-PO Mapping has been shown in the Paper. A review on Mapping has been taken on an online feedback survey and found that mentoring is required in the CO-PO mapping level and interpreting it at hard-shell. CO-PO Mapping for a course has been demonstrated w.r.t. the process followed, and calculations to the end have been explained. There is an opportunity to take PO assessment methods further with mapping levels concentrating on defining competencies and Performance Indicators.

**Keywords**—Course Outcome (CO), Program Outcome (PO), CO-PO Mapping, Competency, Performance Indicators OBE.

### I. INTRODUCTION

THE teaching-learning process is the heart of any educational system at a level and takes the stakes to their wisdom. Outcome-based education has emphasized the same, and the focus of learners' learning is at the center of the teacher's teaching.

In outcome-based education, the education focuses on learners' skill development at Cognitive, Psychomotor, and Attitude levels. The above skill level varies with education streams and level of education from school to higher education colleges & universities. (Spady, 1993) While implementing outcome-based education ensures a certain amount or level of measurement quality has been imparted to the learner.

Measuring of quality of education imparted to students leads to the assessment and evaluation of learning by students in examinations (Yuet Yen Wong, 2015). AICTE has been defined and guided through Examination reforms and Policies, which also support better assessment in studies, measuring outcomes at the course and program levels. Model question papers that will help in the evaluation program skills incorporated by a student.

Exam Reforms (REFORMS, 2018) this reform has guided the Assessment strategy for outcome-based Education (OBE). It suggested a two-step process bringing clarity to PO, Mapping

PO to examinations/examination tools, what skills competencies curriculum of a program develops, and performance indicators through which can assess these competencies. Examination tools that evaluate higher-order abilities and professional skills are also demonstrated (Dr. A. Kavitha, 2018).

It becomes abstruse to justify the CO-PO mapping level defined by the course teacher (Jayasree & Durga, 2018). There becomes a necessity for scientific or any statistical relevance that will rigid the CO-PO mapping level (Reddy, Karuppiyah, Asif, & Ravivarman, 2021). The Mapping of the CO-PO level concerning Competency and Performance Indicators makes it a cakewalk for the course in charge to demonstrate for a third person.

Competencies are simplified statements that focus on different abilities to be attained by the learners. These are Domain-specific and can be used to assess the student's learning ability.

Competencies are statements that showcase what students demonstrate concerning PO from the program curriculum. Each PO and Program Specific Outcome (PSO) can be implied by an ability that is needed to be shown by the program student/learner. This demonstrative ability requires assessment procedures, creating a shared understanding that students want to achieve through their respective programs. A program needs to identify what competencies and various skills can be built in students concerning each PO, these competencies will give an idea for performing indicators through which we can measure these competencies, and subsequently, the quality of PO can be measured.

Performance Indicators (PI) - Measuring tool in Assessment, Performance Indicators are the statements used to evaluate various competencies; they can be designed to find the appropriate level of Competency of each indicator so that instructors can target and students can achieve the acceptable level of proficiency


A feedback survey has been taken, and an understanding of CO-PO mapping levels and how mapping levels are justified is analyzed. The next section describes the feedback survey followed by the methodology proposed and the tool used at the Institute of the same.

*A. Responses of faculties involved in OBE and teaching – Learning Practices*

Online feedback is taken, and responses have been analyzed for the ten questions stated below, responses for understanding


# Assigning the Test Case Priorities Using Butterfly Optimization Algorithm for Software Test

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## ABSTRACT

Software maintenance is the longest process of SDLC. It continues with the distribution of applications till the software is not in operation. Software modifications are an unavoidable aspect of the life cycle of software growth. The optimization of software testing is still an important task, as the average percentage of detected failures (APFD), the average percentage of branch coverage detection (APBCD), and output of time are unsatisfactory in priority test cases. The authors also suggested in this document to give priority to test cases using butterfly algorithms optimally. They use butterfly algorithm with a fitness function specified with a similitude-distance model to optimise the ordering of test cases. Three testing suites selected from the software testing case repository experimented with three benchmarking programmes. The test case prioritization technique (TCP) was better than current works with the butterfly APFD algorithm as the output matrix. Overall, APFD results show butterfly algorithm being a successful competitor in TCP applications.

## KEYWORDS

APBCD, APFD, Butterfly Algorithm, Regression Testing, Test Case Prioritization

## INTRODUCTION

Software testing requires a long-running time and can be the costliest step of the software development process Reid, S. (2004). The checking of applications is understood as the least comprehensive aspect of the development process. Also, testing of applications is done over and over again, because of time limitations and resources it is often done in hurry. In light of this, the Test Case Prioritization application (TCP) has been stated to increase test viability in software tests (Rothermel et al., 1999) (Khatibsyarbini et al., 2017) (Khatibsyarbini et al., 2018) (Jiang & Chan, 2015). First stated by (Wong

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## Experimental and finite element investigation of statistical energy analysis parameters for idealized subsystems

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### ABSTRACT

In the field of acoustic and vibration analysis, statistical energy analysis proven to be an efficient tool for evaluation of the crucial parameters like damping loss factor (DLF), modal density and coupling loss factor of complex structures. In the present study, modal densities and DLFs of idealised subsystems i.e. rectangular plates comprised of different materials were evaluated experimentally and numerically. In addition, the effects of various boundary conditions (BCs) like free-free, simply supported and cantilever on the statistical energy parameters have been studied. The results obtained using both experimental and numerical approaches are in close agreement. In the case of comparison of all the considered materials, the highest modal density was observed for aluminium, whereas the lowest frequency was observed for graphene doped epoxy composite. The highest DLF was observed for GFR epoxy composite, whereas the lowest DLF was observed for stainless steel.

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### 1. Introduction

In the early 19th century, the structural parts used in the automotive and aerospace industries were made from conventional materials such as aluminium, steel, copper etc. The revolution in the area of advanced materials leads to the development of novel lightweight composite materials [1]. The properties of developed composite materials like high damping, high strength to weight ratio, excellent resistance to fatigue, high modulus, creep and corrosion leads to replacement of conventional materials [2]. In the past two decades, many researchers investigated the static as well as dynamic properties of glass fiber reinforced (GFR) composites. The properties like damping and storage modulus play a significant role in the case of design of composite structures [3–5]. The vibrational response of the composite structures has been studied using deterministic methods like finite element method (FEM), boundary element method (BEM), finite volume method (FVM) or statistical approaches i.e. statistical energy analysis (SEA) [6]. The deterministic methods are proven to be effective in lower frequency region and require a high discretization of the structure, making them

very sensitive with respect to changes in the input parameters. Whereas SEA helps to predict the vibrational characteristics in the mid and higher frequency regions effectively as it considers the smooth or ensemble average structural response and less sensitive to changes in the input parameters as it operates on statistical average [7].

The SEA parameters like input power, DLF, modal density and coupling loss factor plays a significant role in path analysis and flow of energy within the idealized subsystems. SEA parameters mainly depend on material properties, geometry, type of junctions used and tightening torque applied at junction between two coupled subsystems [8,9]. The modal density is evaluated by obtaining the ratio of the number of resonating modes per unit particular frequency bandwidth [10]. Ramachandran and Narayanan [11] evaluated the modal density of longitudinally stiffened cylindrical shell using an eigenvalue problem-based solution, based on the whole structure's strain energies and kinetic energies. Borgaonkar et al. [12,14] determined the modal density of idealized subsystems i.e. rectangular plates of different materials experimentally. Bachoo and Bridge [13] formulated mathematical expressions for modal density of GFR composite beams coupled in torsion and bending neglecting the effect of BCs. In addition, they studied the effect of discontinuity produced in the composite beam systems on the variation of modal

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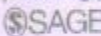
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# Experimental analysis of energy conversion and noise suppression mechanism using polyvinylidene difluoride piezoelectric element

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## Abstract

Energy conversion and conservation techniques are well known for different natural sources but one of the common sources of energy that stays unutilized in the environment is sound energy. The noise around us is a form of unutilized energy. The acoustic energy can be utilized to produce electrical energy. In this article, the testing of the acoustic energy conversion technique is performed. Here the acoustic low amplitude pressure waves generated by the buzzer ringer have impinged over the surface of PVDF (Polyvinylidene Difluoride) Piezoelectric element which has the capability to vibrate after sound impingement. Here the experimental results are taken in the frequency range of 400 Hz to 1300 Hz, in which the highest response occurred at a frequency of 1000 Hz and 91.9 dB, which is  $\pm 50$  mV and the maximum  $V_{rms}$  (Voltage; root mean square) is 35.35 mV by the single piezoelectric unit. The performance of an array of resonating tube chambers as an enclosure to the noise source has been observed to accomplish noise reduction. Then the array pattern arrangement of this entire system has been discussed with the predictions of the output voltage.

## Keywords

acoustic energy, piezoelectric material, energy conversion, noise barrier, electromechanical

## Introduction

A sound wave is a vibration that propagates through a transmission medium such as a gas, liquid or solid. These waves hold energy in the form of pressure. Such sound waves or the form of energy stays unutilized in the environment. Acoustic waves are more mechanical waves that contain some energy and this energy can be easily found in noise and other sound sources. When the sound wave is undesired, it is referred to as noise. Common noise sources include airplanes, vehicles, high-speed trains, power plants, loudspeakers, machines, and expressways. Hence every noise source has been critically understood and the estimation of different noises has been studied such as, In-cabin noise levels during commercial aircraft flights, and the quantitative analysis of the aircraft noise is done for different aircraft.<sup>1</sup> Even under the flight path, and flyover zone of aircraft, large sound pressure levels have been observed.<sup>2</sup> Which are significantly high, and the variations of noise is the challenging part to overcome to reduce noise. But these specific points near the continuous in-use runways can be used. Also, Traffic noise analysis is done with dynamic and experimental observations of urban areas.<sup>3</sup> And

mechanical applications such as centrifugal pumps, simple noise, and low-frequency noise are estimated.<sup>4,5</sup> To point out this problem and give a solution to this noise generation, researchers have found many approaches to control noise.

There are many applications available in the daily environment becoming the sources of noise, and this noise cannot be avoided, so there is a need for noise absorption or suppression, just for a sake of human comfort. Hence many practices have been developed to lower the intensity of noise by absorption or attenuation of waves to make it quite comfortable for human hearing.<sup>6-8</sup>

In the new era, the technology has increased its demand to extract unutilized energy from the environment and to convert it into a usable form such as electrical

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## Review

## Recent advancements in synthesis, rheological characterization, and tribological performance of vegetable oil-based lubricants enhanced with nanoparticles for sustainable lubrication

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## ABSTRACT

Energy and material conservation is an important global issue. In conventional practice, lubricants were selected based on cost, performance, and life, and concern was not given to the impact of lubricants on humans, animals, plants, and the environment. Vegetable oil-based lubricants are gaining more significance in the industrial lubrication market because of their biodegradability, renewability, minimal environmental impact, excellent tribological performance, and stringent environmental regulations. This review paper highlights the most recent advancement in the synthesis, rheological characterization, and tribological performance of biolubricants under different lubrication conditions. Biolubricants are produced from edible and non-edible vegetable oils with limitations such as low thermo-oxidation stability, low hydrolytic stability, and poor low-temperature properties. It can be overcome by modifying vegetable oils chemically and by blending additives in a base oil. The review provides various aspects of biolubricants, such as the chemical composition of various vegetable oils, chemical modification methods used to synthesize biolubricant, physicochemical and rheological properties of biolubricant, tribological performance of biolubricant under various conditions, and various nanoparticles used to enhance the performance of biolubricant. Numerous studies reported that the blending of additives containing nanoparticles enhances the tribological performance of biolubricant and the results obtained from the various researchers have been observed and analyzed in the review. Nanoparticles have gained importance in engineering lubricants because of their shape, size, and other lubrication properties. The properties of biolubricant enhanced with nanoparticles, the dispersion stability of nanoparticles in various biolubricants, the effect of shape, concentration, and morphology of nanoparticles on tribological properties, nanolubrication mechanism, and surface topology and morphology analysis of rubbing surface are emphasized in the review. The research suggests that vegetable oil has a significant prospective to be used as sustainable lubricating oil with nanoparticle additives. The issues limiting the use of biolubricant have also been highlighted with feasible solutions. Additionally, this comprehensive review is highly significant, as it provides new direction and valuable insights to researchers and practitioners towards sustainable lubricants.

## 1. Introduction

The rapid growth in industrialization and demand for a luxurious life has increased the use of advanced machines and equipment. To achieve smooth function and maximum efficiency, the basic need of these machines and equipment is lubrication (Yeichuri et al., 2019). The demand of lubricants has increased tremendously due to the industrial revolution and growing sales of automobiles (Zulkifli et al., 2014). According to a global market survey, 36.8 MMT of lubricants were used in 2019 (Bellini

et al., 2021), increasing demand by around 2.1% every year. In 2020 the global lubricants market size was valued at 125.81 billion USD, and the market is expected to grow at a CAGR of 3.7% from 2021 to 2028. The lubricant market plays a vital role in the country's economy as rapidly depleting fossil fuels causes sudden fluctuations in lubricating prices. Tribological research reveals that one-third of mechanical energy is lost in the form of heat due to friction between rubbing surfaces. In automobile sectors, one-third of the energy losses are caused by piston assembly, transmission system, bearing, camshaft and crankshaft mechanism valve train, etc. (Sharma and Sachan, 2019). Controlling

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# Investigating the Effect of Compression Ratio on Operating Characteristics of Compression Ignition Engine Fueled with Diesel—Ricebran Biodiesel—*n*-Butanol Additive Blends

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**Abstract** The rapid growth in industrialization, environmental pollution, and diminution of fossil fuels are the significant aspects that encourage researchers to seek alternative renewable fuels. The study aimed to examine the influence of the compression ratio on compression-ignition engine tested with rice-bran biodiesel and *n*-butanol additive. An investigation has been carried out for various compression ratios under the full load condition for fixed injection timing 30° before the top dead center. The experimental result indicates that the engine torque increases with the compression ratio for all biodiesel blends. The brake-thermal efficiency shows an increasing trend with compression ratio and blends proportion up to the B30n5 blend and a decline for the B40n5 blend. The average decrease in brake-specific fuel consumption was 14% as the compression ratio increased from 16:1 to 19:1, and brake-specific fuel consumption shows an increasing trend with blending proportion. Hydrocarbon and carbon monoxide emissions were reduced by 40% and 15%, respectively. In contrast, carbon dioxide and nitrogen oxide emissions were increased by 10% and 15%, respectively, with an increase in compression ratio from 16:1 to 19:1. High compression ratio results in high heat release and cylinder pressure. The results reveal that the rice-bran biodiesel with *n*-butanol additives provides comparable performance with diesel and can be used for a diesel engine without modification.

**Keywords** Performance · Combustion · Emission · Ricebran · *n*-Butanol

## Abbreviations

B5n5	Diesel 90% + Rice-bran biodiesel 5% + <i>n</i> -butanol 5% by volume
B10n5	Diesel 85% + Rice-bran biodiesel 10% + <i>n</i> -butanol 5% by volume
B15n5	Diesel 80% + Rice-bran biodiesel 15% + <i>n</i> -butanol 5% by volume
B20n5	Diesel 75% + Rice-bran biodiesel 20% + <i>n</i> -butanol 5% by volume
B25n5	Diesel 70% + Rice-bran biodiesel 25% + <i>n</i> -butanol 5% by volume
B30n5	Diesel 65% + Rice-bran biodiesel 30% + <i>n</i> -butanol 5% by volume
B40n5	Diesel 55% + Rice-bran biodiesel 40% + <i>n</i> -butanol 5% by volume
B10	Diesel 90% + Biodiesel 10%
B20	Diesel 80% + Biodiesel 20%
B40	Diesel 60% + Biodiesel 40%
VCR	Variable compression ratio
CR	Compression ratio
CI	Compression-Ignition
IC	Internal combustion
$m_f$	Fuel flow rate (kg/h)
CV	Calorific value (kJ/kg)
$Q$	Integrated heat release
$P$	Indicated pressure in the cylinder (N/m <sup>2</sup> )
BHP	Brake power (kW)
IHP	Indicated power (kW)
BSFC	Brake-specific fuel consumption
BMEP	Brake-mean effective pressure
BTE	Brake thermal efficiency
EGT	Exhaust gas temperature

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# Adoption of Experiential Learning Approach for Validation of Perpetual Motion Machine of First Kind Concept in Engineering Thermodynamics

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**Abstract**— Educationalists among the globe are innovating and experimenting innovative teaching practices to the students to trigger students involvement, grasp of the concepts and performance. Engaging students in practical and challenging activities is one of the way to engage students in the learning process. The learning through inference drawn from these activities and experience is referred as an experiential learning. Experiential learning has evolved as a superior teaching-learning methodology over conventional classroom teaching. Autonomy in learning to the students and triggering creative thinking in students are the key aspects of experiential learning methodology. Educationalists have adopted experiential learning to science and technology, medical, management and engineering disciplines and is being more popular day by day. This article presents experiential learning model applied to engineering thermodynamics course (subject) for validation of basic thermodynamic concepts. Student validated working of a machine without any work input by reproducing the machine claimed in the videos uploaded on video sharing platforms. Flexible learning system helped students to have proper understanding of basic concepts, laws of thermodynamics and understanding and to improve academic performance. The activity conducted resulted in the improvement in the overall CO attainment by 14.12% along with improvement in the average marks of the students for UT1, UT2 and ESE assessment collectively by more than 55%.

**Keywords**— Experiential learning; learning by doing; engineering thermodynamics; flexible learning framework.

## I. INTRODUCTION

EXPERIENTIAL learning is an active learning strategy that involves learning through experience gained through activities like experiments, field observations, hands on experience etc. It enables students to learn by doing by their own. It helps students, trainee and learners to inculcate new set of skills, viewpoint by involving in an experiential task and analysis and synthesis about the experience. The critical analysis and synthesis, initiative and decision making opportunities for students, becoming accountable, intellectual, social and physical involvement of students and learning opportunities to students are key elements of experiential learning.

It is evident that the conventional classroom teaching-

learning involving ‘chalk and talk’ approach proves unproductive for science and engineering education (Freeman et al., 2014; Waldrop, 2015). In order to improve students learning, active learning techniques like group problem solving and demonstrative examples have become essential part of classroom teaching (Kober, 2015). In addition to this, active learning approaches like ‘peer learning’ and ‘think-pair-share’ are becoming more popular amongst educationalist in recent year to improve learning of students (Lom, 2012). Learning experience in science and technology can be enhanced by including hands on exercises like laboratory session (Freeman et al., 2014). At present, many laboratory exercises have fixed learning framework with fixed set of instructions (Handelsman et. al., 2004). By implementing creative and flexible learning framework that gives more learning freedom to students, considerable utilization of practical sessions can be done (Handelsman et. al., 2004).

Inference drawn from the research carried out in a Spanish business school shows that adopting experiential learning activities helps students’ grasp of theoretical concepts and improves academic performance (Rodriguez and Morant, 2019). Patil and Meena implemented experiential learning to computer engineering undergraduate students at a private engineering college in India (Patil and Meena, 2018). Powar and Patil employed 3D printing as a learning tool for undergraduate mechanical engineering students developed a technology-enhanced project based learning (TEPBL) model (Powar and Patil, 2022). It was found that utilizing experiential learning activities enhances the employability of engineering students (Patil and Meena, 2018). Gadola and Chindamo presented a case study of Motostudent event, Europe and Formula SAE competition (Gadola and Chindamo, 2017). It was concluded that, engineering student competitions involves students in experiential learning to an open-ended multidisciplinary problem and triggers students’ creativity and innovation (Gadola and Chindamo, 2017).

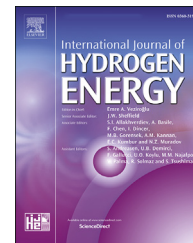
Engineering thermodynamics course is a part of undergraduate mechanical engineering programme at Rajarambapu Institute of Technology (RIT), Rajaramnagar, India. Course content of engineering thermodynamics includes basic thermodynamic concepts like system, boundary, surroundings, first and second law of thermodynamics, entropy, exergy, properties of gases and properties of steam. The



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# Performance analysis of sodium alanate hydride reactor with different nanofluids

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## HIGHLIGHTS

- Developed and validated mathematical model of sodium alanate based hydride reactor.
- Used nanofluid as a heat exchange fluid.
- Presented performance for  $\text{Al}_2\text{O}_3/\text{HTF}$ ,  $\text{CuO}/\text{HTF}$  and  $\text{MgO}/\text{HTF}$  Nanofluids.
- Absorption time is improved by 14% for given conditions.
- Reported up to 10% enhancement in the heat exchange rate for  $\text{CuO}/\text{HTF}$  nanofluid.

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## ABSTRACT

The thermal management of the hydride based hydrogen storage reactor is the key factor to realize the complete storing potential of hydrides. In this regards a hydride reactor filled with sodium alanate in multiple tubes is numerically analyzed for absorption process. Based on various governing equations, a mathematical model of hydride reactor is developed and validated with the help of ANSYS Fluent. The hydride reactor uses mainly water or oil for heat exchange during hydrogen sorption. In the present study conventional heat transfer fluid (HTF) is replaced with the nanofluid since it has a greater heat exchange properties. The  $\text{CuO}/\text{HTF}$ ,  $\text{Al}_2\text{O}_3/\text{HTF}$  and  $\text{MgO}/\text{HTF}$  nanofluids are selected based on previous studies and results of numerical experiment are recorded. The outcomes are attained for various parameters such as material and concentration of nanoparticles, supply pressure of hydrogen and inlet temperature of heat exchange fluid. The  $\text{CuO}/\text{HTF}$  nanofluid with concentration of 5 vol% exhibited better rate of absorption in comparison with other vol% concentrations and other selected nanofluids. It shows improvement in hydrogen absorption time up to 14% under selected conditions. Additionally, it is observed that  $\text{CuO}/\text{HTF}$  nanofluid with 5 vol% concentration is thermodynamically superior to other selected nanofluids; as a result it enhances the rate of the heat exchange up to 10% for hydride reactor. It is realized that the performance of  $\text{CuO}/\text{HTF}$  nanofluid with 5 vol% concentration is superior among picked nanofluids. Therefore for the hydride reactor the use the nanofluid is advantageous.

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## DESIGN AND SIMULATION OF AUTOMOTIVE RADAR FOR AUTONOMOUS VEHICLES

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### Abstract

Modern automobile technology is pushing towards maximizing road safety, connected vehicles, autonomous vehicles, etc. Automotive RADAR is core sensor technology used for ADAS (Advanced Driver Assistance Technology), ACC (Adaptive Cruise Control), AEB (Automatic Emergency Braking System), traffic assistance, parking aid, and obstacle/pedestrian detection. Despite being inexpensive, RADAR technology provides robust results in harsh conditions such as harsh weather, extreme temperature, darkness, etc. However, the performance of these systems depends on the position of the RADAR and its characteristics like frequency, beamwidth, and bandwidths. Moreover, the characterization of varied materials like layers of paint, polish, primer, or layer of rainwater needs to be analyzed. This performance can be predicted through real-time simulation using advanced FEM software like Altair FEKO&WinProp. These simulations can provide valuable insight into the performance of the system, allowing engineers to optimize the system for specific use cases. For example, simulation can be used to determine the optimal parameters of the RADAR system for a given application. This information can then be used to design and build a physical model or prototype that is optimized for the desired performance. These simulations play a prominent role in determining appropriate data collection and sensor fusion, which reduces the cost and time required for the development of a physical model or prototype. The continued growth and demand for advanced safety features in vehicles further highlight the importance of RADAR technology in modern automobile technology. By accurately characterizing the environment and simulating the

## Performance Testing of Multicylinder Compressed Ignition Engine with Dual Fuel Mode of CNG with Biodiesel and Diesel

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### ABSTRACT:

The experimental investigation was performed on a multicylinder CI engine used for off-road applications with dual fuel modes of CNG-biodiesel, CNG-diesel and CNG-biodiesel-diesel. The study aims to identify the maximum possible replacement of liquid fuel by CNG and investigate the engine's performance and emission characteristics under dual fuel mode. Biodiesel used for the study is prepared from waste cooking oil using the transesterification method. Engine performance and emission characteristics are tested for D100, B100 and B60 fuels with CNG supplied in various quantities up to the engine can take at respective operating conditions. The test was conducted at a constant speed of 1500 rpm and varying loads of 10%, 25%, 50%, 75% and 100% of full load. The liquid fuel replacement by CNG is obtained in the range of 54% at low loads and 84% at high loads. The brake thermal efficiency is decreased for dual fuel mode at low loads but improved at high loads. A substantial reduction in the smoke and NO<sub>x</sub> emissions and an increase in CO and HC emissions were observed for the dual-fuel mode. The biodiesel-CNG dual fuel mode significantly reduces greenhouse gas emissions.

### KEYWORDS:

Dual fuel mode with CNG; WCO Biodiesel; Diesel; Engine performance; Emission characteristics

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### NOMENCLATURE:

BMEP	Brake Mean Effective Pressure
BSEC	Brake Specific Energy Consumption
BTDC	Before Top Dead Centre
BTE	Brake Thermal Efficiency
CA	Crank Angle
CI	Compression Ignition
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CR	Compression Ratio
CO <sub>2</sub>	Carbon Dioxide
DI	Direct Injection
HC	Hydrocarbon
LPM	Litres per minute
NO <sub>x</sub>	Oxides of Nitrogen
NTP	Normal Temperature and Pressure
PM	Particulate Matter
RTD	Resistance Temperature Detector
SI	Spark Ignition
TDC	Top Dead Centre

2050. The rising energy demand and continuous destruction of fossil fuels lead to the energy crisis. The energy developed in the industries and transportation sectors primarily from mineral oil and coal. Specifically for the automobile sector, almost all the fuel required for the IC engine is derived from petroleum oil, which is a non-renewable source of energy and will deplete in the near future [3, 4]. Simultaneously more concern is given to environmental issues such as emission, acid precipitation, stratospheric ozone depletion and global climate change. The use of clean and green energy is becoming a growing concern for the transport sector and industry. Therefore, it motivates the researcher to search for renewable and alternative fuels that will minimize or replace the use of fossil fuels [5].

Biodiesel is a good alternative renewable energy source for use in IC engines [6, 7]. To sustain the energy crisis and consider the concern over pollution, a substitute for petroleum fuel needs to be identified. A tremendous amount of petroleum fuel is imported from foreign countries, which is another reason for the development of alternative fuels. The alternative fuel should be developed from a renewable source of energy and give less emission [8, 9]. As the Compression Ignition (CI) engine is widely used in the industry and transport sector, searching for alternative fuels for CI engines is essential. The dual-fuel CI engine uses gaseous fuels in

## 1. Introduction

In the last decade, substantial growth has been observed in India's economy, which ultimately increased energy demand and greenhouse gas emissions [1, 2]. As per the energy, environment and sustainable report, the energy demand is expected to increase by 1.5 to 3 times up to

## NEED OF HYBRID ELECTRIC TWO WHEELERS ON INDIAN ROADS TO SUSTAIN GREEN ENVIRONMENT

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### ABSTRACT

*This paper provides a comprehensive study of the recent work of Hybrid Electric Two Wheeler (HEVs). The paper describes the development and the need of HEVs. Over the decade, we have observed various kinds of research in the area of Electric and hybrid electric vehicles but till now there is no such expected number of vehicles on Indian and abroad roads. All we know that the major issues in pollution are from the emissions from the vehicles. Through this paper, we are trying to put a basic comprehensive study of why we have to rethink the need of hybrid electric vehicles? Up to the fulfillment stage of availability of the required facilities and infrastructure for the on-road electric vehicles we have to use or develop reliable hybrid electric vehicles, which will be propelled by the existing I. C. engine and battery power. And simultaneously, it is required to develop the revolution facilities and infrastructure for the pure battery powered or say Electric Two Wheelers (EVs).*

**KEYWORDS:** Hybrid Electric Vehicles (HEVs), Electric Vehicles (EVs), Internet of EVs, Revolution Requirement.

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### INTRODUCTION

In today's fast moving world, having a vehicle is very common thing. But till problems related to pollution and vehicle emission is not much controllable yet. New environment friendly and affordable power systems like Electric and Hybrid Electric Two Wheelers has become very important and thus, they are needed to be installed urgently. In India, continuing since 2010, the Government of India and State Governments have announced and are helping through many sources like start-up support, subsidies on the vehicles and the parts, free registration, some models were allowed to drive without Driving License, No Toll etc. The benefits are announced and given for the users and manufacturers of Electric Vehicles, Hybrid Electric Vehicles and Solar Powered vehicles.

But till now, the electric vehicles are not spread or popular as expected by the manufacturers and government. We are not observing numbers of electric vehicles and models on roads. Else, we have observed that numbers of dealers have closed their business.

Even the MNCs or OEMs like Hero or TVS have not got such success in this business. Obviously they are adopting the latest technology, latest research and development. But they could not get success. The end customers / end users are not reliable on the Electric Two Wheelers. The companies and the technical people are trying to spread the technology. We might reliable on battery performance development, life and maintenance, new arrival of Lithium-Ion batteries. But till the end customers are not ready to use the electric two wheelers. All we know, the use should be increased. But it will happen when we are able to develop reliable vehicles which will be preferred by the end users. Based on these observations, we are hereby putting together this study. To develop awareness, we are



## PAPER

# Investigation of the damping behavior of shape memory alloy-nitinol reinforced composite

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11 November 2022Ranjit Anil Patil<sup>1,\*</sup>, Santosh B Rane<sup>1,\*</sup> and Samir B Kumbhar<sup>2,\*</sup><sup>1</sup> Department of mechanical engineering, Bharatiya Vidya Bhavan's Sardar Patel College of Engineering Andheri (West), Mumbai Maharashtra 400 058, India<sup>2</sup> Rajarambapu Institute of Technology, Rajaramnagar 415414 Affiliated to Shivaji University Kolhapur Maharashtra, India

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E-mail: [ranjit6044@gmail.com](mailto:ranjit6044@gmail.com), [s\\_rane@spce.ac.in](mailto:s_rane@spce.ac.in) and [samir.kumbhar@ritindia.edu](mailto:samir.kumbhar@ritindia.edu)**Keywords:** damping behavior, vibration control, shape memory alloys, elastomer, nitinol reinforced composite, damping factor, damping model

## Abstract

The use of Shape Memory Alloy (SMA) recently increased in smart structures. It is essential to investigate the impact of viscoelastic material, and transformation temperatures of SMA on dynamic behavior, especially the damping capability of the SMA reinforced composite. In this paper, the damping constants of SMA and viscoelastic material are evaluated experimentally, and a damping model based on experimental results is proposed for the composite. The effect of SMA wires in combination and selective activation has been studied using the proposed model and validated experimentally. It has been observed that damping predicted by the model is close to damping calculated by experimentation. Also, damping varies with the transformation temperatures of SMA. Thus, dynamic control of the SMA reinforced composite is feasible by controlling transformation temperature. The composite studied in this work can shift the damping by 9.58% by activating all nitinol wires.

## 1. Introduction

Smart materials like shape memory alloy (SMA), piezoelectric materials, Magneto rheological elastomers (MRE), Magneto-rheological fluids (MRF), electro rheological fluids (ERF) play a vital role in vibration attenuation and controls due to their inherent ability to change the mechanical properties with respect to external stimuli [1–12]. Nowadays, many researchers are using these smart materials in combinations to increase their effectiveness in vibration control [13–15]. Recently, the use of SMA has been increased in smart structures to make them more adaptive and alter the dynamic performance of the structure [16–21]. The SMA has a unique ability to change its modulus, consequently, stiffness with respect to external stimuli like heat and magnetic field. Hence it is the best candidate for stiffness tuning [13, 22–32]. In vibration control, along with stiffness tuning, vibration damping is also essential; hence, it is required to explore. Materials like silicon rubber having viscoelastic properties effectively increase the vibration-damping ability of the structure [33–35]. Viscoelastic materials have significant hysteresis damping and can be combined with SMA material to have the dual advantages of stiffness tuning and structural damping. Many researchers explored the capability of such combinations in vibration control by constructing composites, testing those in a laboratory, and using simulation software [36–51].

In this work, the SMA-reinforced viscoelastic composite has been investigated for its damping ability by tuning the properties of SMA through temperature change and activating a number of wires selectively. In this process, the damping properties of individual SMA wires have been experimentally evaluated for different temperatures. Also, the damping properties of viscoelastic material have been evaluated. Nitinol SMA and silicon rubber as viscoelastic materials have been used for fabricating the composite. The effect of wire combination and selective activation on damping behavior has been studied mathematically by taking inputs

## Article

# Experimental Investigation and Optimization of AZ31 Mg Alloy during Warm Incremental Sheet Forming to Study Fracture and Forming Behaviour

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**Abstract:** The main purpose of this research work is to study the forming limit and fracture behaviour of the AZ31 magnesium alloy, as well as to improve the formability and surface roughness of parts formed using the warm incremental sheet forming (ISF) process. For the ISF process, AZ31 Mg alloy sheets were used. Initially, Taguchi orthogonal L27 arrays were used to design experiments, and a framed multi-objective optimization problem was solved using the grey-fuzzy method. The strain-based forming fracture limit diagrams (FFLD) were plotted after a variable wall angle test. The grey-fuzzy reasoning grade (GFRG) is calculated in this study by combining grey relational analysis (GRA) and fuzzy rationale. For the AZ31 Mg alloy, the maximum GFRG value was obtained for the following forming combinations: step depth 0.3 mm, feed rate 500 mm/min, spindle speed 700 rpm, and tool diameter 10 mm. Then, ANOVA was used to determine the importance of parameters on the responses, and it was discovered that the step depth has the greatest influence (68.78%) on GFRG value, followed by the feed rate (16.56%). The fracture behaviour of the Mg alloy was studied using fractographs. Later, FE simulation was used to validate the strain value obtained from experimentation and to investigate the effect of process parameters on responses.



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**Keywords:** magnesium alloy; incremental sheet forming; grey-fuzzy optimization; variable wall angle; warm forming; optimization

## 1. Introduction

For regular sheet metal forming, specialised equipment, such as dies and punches, and metal cutting and bending machines, are required to form the required part. As a result, the time and cost associated with the traditional sheet metal forming process are greater for customised products. Furthermore, any minor change in the part design may turn it into a herculean task because all of the requirements will be altered. Consumer demands are becoming more specific and personalised, rendering the traditional metal forming process obsolete. For these reasons, highly flexible forming methods with high dimensional precision are required. As a result, an additional efficient and adaptable forming process, namely incremental sheet metal forming (ISF), has evolved.

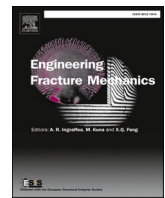
The ISF meets a unique set of requirements, including forming on standard CNC machines, die and punchless forming, low stress generation, rapid modification capability, higher material formability, and a superior surface finish at a low cost. Because of these characteristics, the ISF process is well suited for rapid prototyping in small- and medium-sized batch manufacturing [1]. Hence, determining the forming limit in the ISF process is very important. Pandivelan et al. [2] examined the formability of the sheet during the ISF process using a straight groove test and found that the formability was greatest in the rolling direction. Numerous researchers have investigated the strain-based forming limit for steel and its alloy sheets. Yoganjaneyulu et al. [3] observed that the formation of dimples, cracks, voids, and pits from a fractured surface disrupts the forming limit of



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# Engineering Fracture Mechanics

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## Development of Virtual Internal Bond method based material model for Carbon fiber and its application to Carbon fiber reinforced epoxy system

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Virtual internal bond  
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Damage modeling

### ABSTRACT

The present work contributes to the current state of art in fracture modeling of carbon fiber through development of virtual internal bond (VIB) model based on Tersoff-Brenner potential for carbon fiber. The underlying VIB method is multiscale in nature and the stress-strain relation which while retaining the microscopic attributes handles crack initiation and propagation without addition criterion. A variant of VIB method viz. multi-dimensional virtual internal bond (MVIB) method is employed to model epoxy resin, wherein the stiffness involved in the interaction potential is penalized based on the strain levels to capture damage. Following calibration based on elastic properties and tensile strength, the potential of the current work is demonstrated through simulation of damage in two-dimensional assemblage of carbon and epoxy under the action of bi-axial loading characterized via bi-axiality ratio.

### 1. Introduction

The excellent mechanical properties viz. high specific strength, specific modulus, fracture toughness and corrosion resistance exhibited by carbon fiber reinforced polymer (CFRP) composite are usually attributed to the layout and proportion of carbon fibers relative to the polymer and are leading a transformation from the conventional metal-based to polymer-based structures in areas as diverse as naval, aviation, automobile [3,48,49]. The carbon fiber reinforced polymer composite (CFRP) consists of two parts: the carbon fiber as the reinforcement and polymer resin (e.g. epoxy) as the matrix. The former provides strength and the latter binds the reinforcement together [2]. The primary element of CFRP is a carbon filament produced from the precursor polymer such as polyacrylonitrile (PAN), rayon or petroleum pitch [3]. CFRP composite parts can be manufactured by using methods like molding, vacuum bagging, compression molding and filament winding [4]. A large quantum of experimental and modeling research centered around CFRP has simultaneously emerged [e.g. 2–3, 5, 6–9] and researchers have either attempted to enrich the mechanical properties or predict the fracture process and its dependent parameters via damage models. The concerned experiments demand state-of-art instrumentation and setups making them quite expensive and niche. Hence although insightful, experiments are always limited in number and variety. On the other hand, computer simulations can cover up for the limited experiments, provided the model captures the multiscale effects ranging from micro-structural phenomenon like interaction amongst fibers, interaction of fiber with adjoining

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# Enhancement in Student Employability by Providing Internship and Project Track

Ajinkya K. Patil, Pruthviraj C. Chavan, S.V. Chatanya, Sharad D Patil.

**Abstract**—In order to strengthen its final year engineering students' worldwide competency, our institute decided to launch four choice-based project tracks in 2017-18. According to this method, students can select one option from traditional capstone project (CP), undergraduate research experience (URE), entrepreneurship development (ED), and industry internship & projects (IIP). The current work focuses on industry internship & projects (IIP), how it affects students' careers, employability chances assessment techniques perceived by students and the institute, and the significant steps done to address such challenges. Students and their evaluators were surveyed to analyze the results of the four track project method. Students who choose the IIP track were found to have improved their skills. Self-learning capacity, self-assurance, and critical thinking all showed satisfactory growth. The pupils' resumes were aided by this. In order to improve students technical understanding Institute again decided to change in four track structure into three track in 2020-21 by making CP track compulsory to each students which will starts in second semester of third year and ends after first semester of final year. Students that undergo compulsory the CP track in their third year were successful in gaining abilities like teamwork, creative problem-solving, and time management. Which can helpful to them for better survival in Industry during Internship. Overall, it has been noted that the institute's placement percentage increased from 78.68 to 82.32 and average package have been increased from 2.60 LPA to 3.71 LPA.

**Keywords**—placement; internship; projects; employability  
**JEET Category**—Industry and Academia Collaboration

## I. INTRODUCTION

In today's competitive environment, employers look for engineering school graduates who are prepared for the workforce. In India, there are over 4282 engineering institutes. Every year, more than 30 Lakh students from diverse courses graduate from these institutions. Engineering students in this situation must contend with intense competition while looking for a job that suits their preferences. Consequently, the growth of engineering students is greatly influenced by teaching and learning approaches. According to the engineering education curriculum, final year students are required to complete a significant project. Additionally, students must complete a group project on a specific issue related to their chosen

engineering field. Students are not exposed to real-world job situations, even though this practice is helpful for developing skills like critical thinking, analysis, teamwork, project management, etc. (Waychal, 2016). Entrepreneurship education is seen as complimentary to the current engineering education system. Some students want to launch startups after graduation, but they don't acquire the necessary skills and expertise before they graduate. To improve students' chances of success in the actual world of employment, the curriculum needs to move its emphasis more toward experiential learning methods. Cooperative education, internships, service learning, research, study abroad, fieldwork, and other educational and professional experiences like entrepreneurial development are all included in the experiential approach (Gashaw,2019). All of these experiences serve as a bridge between what is taught in the classroom and job expectations. Institutions and employers collaborate in cooperative education so that students can apply what they learn in class to the workplace. This improves decision-making skills and working experience (Jung and Lee, 2017). Students also receive limited-term work experience via internships. Paid internships under a professional's supervision are available. The main distinction between cooperative education and an internship is that cooperative students are paid for their work and are treated like full- or part-time employees. In the case of internships, students get paid nothing or little. According to a literature review, the majority of institutions favor internship programmes lasting four to six weeks within the four-year degree programme. Internships and cooperative education can help students embrace new ideas, generate possibilities, and become more conscious of concerns affecting their communities (Gol et al.,2001). A fruitful internship might provide important information for choosing the course of future education or job. An internship is a chance to apply and advance knowledge and abilities connected to a particular industry, as well as integrating internships into regular courses can be difficult for many universities (Parishani, Khoroshii, 2016). (Renganathan et al.,2012). Although the advantages of internships have been the subject of several studies, few students and academic institutions actually implement these programmes. The planning of internships should start with assigning the industries, allowing enough time for the internship, providing adequate supervision and assistance, and providing financial support for the interns (Gashaw,2019). Otherwise, institutions and students may encounter a variety of difficulties. Our institute opted to advance an experiential learning paradigm after considering the existing state of the world. The institute started off by surveying 500 pupils. After graduation, 65% of students expressed a desire to work for

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# Design Thinking with ICT Tools: An Approach to Enhance Engagement in Design Problem and Practical Exposure

Pruthviraj C. Chavan, Ajinkya K. Patil, Ganesh R. Chate and Vinayak R. Malik

**Abstract**—These instructions give you guidelines for preparing **Abstract**— Students were unable to gain exposure to think practically, solve real-world problems, and think critically in recent years following pandemic situations, so design thinking is a rapid change in engineering education strategies to increase students' engagement in imparting knowledge and skills remotely to the students. The traditional approach to teaching-learning strategies has given way to some advanced methods utilizing various modern approaches such as design thinking. The engagement of students actively and learning collaboratively with thinking ability is the major challenge in the learning of courses like metrology. The paper is a report on the author's use of the design thinking approach for the learning and active participation of third-year mechanical engineering students at Rajarambapu Institute of Technology in Rajaramnagar. This paper describes the use of the design thinking approach for the metrology course and summaries of students' active participation and improvement in terms of students' "Learning Coefficient (LC)" based on the responses collected. The learning coefficient is represented by a number ranging from 0 to 1, with 0 indicating fewer interactive sessions and 1 indicating extremely interactive sessions. These coefficients reveal how much learning is taking place. Furthermore, the impact assessment shows that course results and course outcome attainment were significantly improved. The students' feedback indicates that they had a great time and appreciated the opportunity to learn.

**Keywords**— Collaborative learning; Course outcomes; Design thinking; Learning coefficient; Students' feedback.

## I. INTRODUCTION

Teaching-learning of courses is not only limited to, delivery in the classrooms, physical performance, and recording observations. It combines new active learning strategies for interactive learning, critical design thinking, and practical experience. Students' presence is not limited to physical attendance; it also allows instructors to consider how students will be engaged, involved, learn, and think in a planned manner. Interaction among students as well as faculty and students during metrology course learning has become an important aspect of successful teaching-learning of courses. The culture must be such that students can actively participate, debate among themselves, and gain shop floor experience while

learning. To create an active learning environment and increase students' skills during sessions, the regular class culture must be such that all can think, engage actively, share their views, and evaluate. The lecture delivery techniques create a link between students for easier learning and understanding, as well as ensuring that positive solutions are provided by the students.

Many instructors now use design thinking as their approach. Given the needs of engineering education, instructors have begun to use these modern approaches to teaching and learning in engineering education.

### A. Inspiration for the Study

Because of a lack of active participation, attention to learning, and revision during the teaching-learning process, students are unable to comprehend everything that the teacher teaches. If these actions are taken and these corners are modified, it is hoped that the teaching-learning process will produce significant results. The author was inspired by the interactive learning of the students and the thing in this way to use modern approaches with ICT tools to improve the effectiveness of the teaching-learning process.

## II. LITERATURE REVIEW

This section explains the overview of the research articles and recognizes the gap in the use of modern approaches in the teaching-learning process.

Design thinking was discussed by Judy Matthews and Cara Wrigley (2017) as an approach used in higher education. The researchers used various design thinking approaches to create a preliminary map of some of the higher education business programs. Stanislav Avsec (2021) investigated design thinking as a transformative learning approach and found that design thinking, when supported by transformative learning theory, can be conducive to the development of higher order thinking skills and meaningful learning experiences that influence a pedagogical shift and perspective of pre-service teachers from a variety of majors. Teaching design thinking to students, according to Jacqueline E. McLaughlin et al. (2019), is a skill-based tool to prepare students for problem-solving in complex healthcare environments and to create, implement, and refine health professions curricula and training programs. Aparna

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Review / Научный обзор

## Diasporic consciousness in contemporary Indian women's fiction in English: at a glance

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**Abstract.** Diasporic literature is a pivotal term in literature that includes the literary works of the authors who are the outsiders for their native country but their work is deeply rooted in homeland by reflecting native culture, background, displacement and so on. Indian women's literary work is at the forefront of diasporic literature. The advent of Indian women novelists on the literary horizon is an important development in the Indian English literature. These women writers have also contributed to other genres, such as drama, poetry and short stories, not only in English but also in regional languages like Hindi, Marathi, Bengali, Punjabi, Tamil, Kannada and so on. Some modern women writers flourish their writing in the form of fables as a literary genre in an impressive way to focus on the specific themes. In last two decades, Indian women's writing in English is blossomed, both published in India and abroad. The present paper is the review of diasporic consciousness in select works of contemporary Indian women novelists. It focuses on the attempt to highlight the quest for identity of those women who played a crucial role in defining themselves through their literary work in diasporic background.

**Keywords:** diaspora, Indian English fiction, Indian women novelist, quest for identity

**Conflicts of interest.** The author declares that there is no conflict of interest.

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## Диаспорное сознание в современной индийской женской прозе на английском языке: краткий обзор

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**Аннотация.** Диаспорная литература – ключевой термин в литературе, включающий в себя литературные произведения авторов, которые являются аутсайдерами для своей родной страны, но их творчество глубоко укоренено на родине, отражая местную культуру.

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