Principal's Message

With the release of the first edition of our Research Bulletin, we are trumpeting to the world about our capabilities in developing new technologies relevant to both Academics and Industries. This endeavour will provide opportunities for all of us to work together closely on topics of our interest, thereby leading to better discoveries in future. Let this also be an inspiration for the younger generations to dream about more achievements in their career.

Dr. Jayanand B

Here goes our whole-hearted appreciation for these wonderful team achievers

(News on Page No.2)

EMERGE

GEC's Proud Moments

IRAC, GEC Thrissur considers it a great privilege and honour to congratulate three of the faculty members and two students who have secured Ph. D in 2018.

Professor Ali M A   Professor Sandhya M   Professor Sajan M P   Mrs. Benzy V K   Mrs. Anu P Anil

Professor Ali M A, Dept. of MCA, GEC Thrissur got Ph. D from the University of Calicut for his thesis entitled "Physical layer improvement techniques in 4G/5G wireless communication networks". He did his research work under the supervision of Dr. Jasmine, Professor, Dept. of Electrical Engineering, GEC, Thrissur.

Professor Sandhya M, Dept. of Mechanical Engineering, secured her Ph. D in Mechanical Engineering from Cochin University of Science and Technology for her thesis "Investigation on Flow Characteristics of Jets Emanating from Round and Rectangular Nozzles with and without Bevel".

Professor Sajan M P, under the supervision of Prof. Shalij P R, Dept. of Production Engineering, GEC Thrissur, took his doctoral degree from the University of Calicut on "Investigation on lean practices in manufacturing micro small and medium enterprises and their effect on sustainability performance".

Mrs. Benzy V K, under the guidance of Dr. Jasmine E A, Professor, Dept. of Electrical Engineering secured her doctoral degree from the University of Calicut for her work on "Multiparameter index for the estimation of Depth of Anaesthesia based on Signal Processing and Soft computing Techniques".

Mrs. Anu P Anil, was a CERD fellow of Production Engineering department and worked under the guidance of Dr. Satish K P, Professor, Dept. of Production Engineering on "An empirical investigation of relationship between total quality management practices and organization's performance in Indian context". For this she was awarded Ph. D by the University of Calicut.

Centre for Robotics and Artificial intelligence

It is our great pleasure to announce that a Nodal Centre for Robotics and Artificial Intelligence (AI) is being established at Govt. Engineering College, Thrissur with two fold objectives:

- To Provide facilities for frontline Research in Robotics and AI
- To organize Training and Skill Development Programmes for technical institutes in the field of Robotics and AI.

The facility is envisaged to be shared by various Engineering colleges, Polytechnics and Technical high schools and will be functioning as a Centre of Excellence in ROBOTICS & AI. The centre is funded by the Higher Education Department, Govt. of Kerala and is expected to start functioning by the 3rd week of March 2019. Initial fund allocation is Rs. 99.6 Lakhs. GEC Thrissur feels honoured to have Dr. Lalu P P and Dr. Sudheesh R S, Dept. of Mechanical Engineeringg respectively as Coordinator and Co-cordinator of the centre. As part of its initiative to engage in collaborations with Institutes of global stature, we are in the process of establishing a tie up with Toyota Technological Institute, Japan in the field of Self Driving Vehicles. Prof. Vijay John from TTI Japan visited the campus and engaged a session with a few selected students from all branches of engineering on 9-12-2018.

GEC is very much delighted to congratulate Prof. Ramachandran K K, for his great achievement and recognition

Prof. (Dr.) Ramachandran K K, Dept. of Mechanical Engineering, participated in the 7th Global Conference on Materials Science & Engineering (CMSE2018) held from 1st to 4th November 2018 at Xi'an Technological University, Xi'an, China as an INVITED SPEEKER. There he delivered a speech on "*Mechanical and microstructural characteristics of dissimilar GTA welded HSLA steel / AISI316L stainless steel butt joints*" and he received ***Best Speaker Award*** from the Conference Chair, Dr. William M. Cox, Director, Corrosion Management, United Kingdom. The conference was organized jointly by the Xi'an Technological University, Xi'an, China; Shaanxi Key Laboratory of Optoelectronic Functional Materials and Devices, China & Shaanxi Society for Corrosion and Protection, China.

Here goes our whole-hearted appreciation for these wonderful team achievers

A team of Interdisciplinary student project group - Alina Annie Furtado of S3 CSE, Manal Jaleel, Malavika Krishnan, Sebin Wilson, Vaisakh Mohan of S3 EEE, Annie Sajayan, Aswini Kamath, John Thattil of S5 ECE won second prize for their 'ParksGlove' design idea - A wearable device to reduce tremors of Parkinson's dieseas patients - in Idea pitching competition 'EMERGE 2018' organised by EXCEL 2018 of Model Engineering College, Thrikkakara supported by Kerala Startup Mission. Here is this outstanding project winning the second prize from 19 short listed teams selected out of 132 abstracts received for the event. Significantly, this project is submitted for funding from KSCSTE under the Principal Investigator Prof. Sindhu N, ECE dept and Co investigator Mr. Jai John, Dept of ECE.

Best wishes for the future aspirants

During the current academic year (2018-19), 15 students from different branches under KTU have enrolled for the research work leading to Ph. D. Electrical Engg. (5), Mechanical Engg. (3), Mathematics (2), Civil Engg. (2), Chemical Engg. (1), Electronics Engg. (1), Production Engg. (1).

Total number of research students in our college is 114. (Registered in Calicut University -58, KTU- 56)

Congratulations to the Investigators of sanctioned projects

Dept. of Mechanical Engg. Project title: *"Development of Thermal Tomography for the detection of breast cancer and to predict the size and location of cancerous tissue".* It is a collaborative project with C-MET Thrissur, having duration of 2 years. Investigators: GECT **Dr. Sudheesh R S & Dr. Rekha L**, C MET: Dr. Seema A and Dr. Muralidharan M N. Project outlay for GECT: 16 lakhs.

Dept. of Civil Engg. Project title: *"A Novel and Cost Effective Method for Characterization of Rheological Behavior of Concrete".* Principal Investigator: **Dr. Nowshaja PT,** Student investigators: **Abdul Bari, Akhil K, Anjima C.S., Sobhin Raghavan** (S7 CEA). Details of funding: KTU student project funding for Rs. 50,000/-

CONGRATULATIONS!

to the Contributors of the Journal Articles

Mechanical Engineering

Arun M S & Uday Chakkingal, "Workability Limits of Magnesium alloy AZ31B Subjected to Equal Channel Angular Pressing", Journal of Materials Engineering and Performance (2018), 27(3), pp. 1352-1360.

Abstract: Equal channel angular pressing (ECAP) is an important severe plastic deformation (SPD) process to produce ultrafine grained microstructures. This investigation examines the influence of different passes and processing routes of ECAP on improving the workability of Mg alloy AZ31B. The ECAP was carried out for three passes using a die of angle 120° using processing routes Bc and C. Workability limit diagrams have been constructed and workability data were analysed using five different workability criteria. Pass 2C specimens exhibits better workability compared to other passes. Also, the Freudenthal workability criterion is more suitable for prediction of failure in this alloy.

Sandhya M & Tide P S, "Computational Analysis of Subsonic Jets from Rectangular Nozzles with and without Bevel, Journal of Spacecraft and Rockets", American Institute of Aeronautics and Astronautics (**AIAA**) (2018), 55(3), pp.749-763.

Abstract: Numerical simulations of a turbulent compressible subsonic jet from baseline rectangular nozzles with aspect ratios of 2:1, 4:1, 8:1, as well as its beveled nozzles (both long and short), were carried out using a commercial computational fluid dynamics software. The Mach number at exit for the aforementioned nozzles was 0.9. Simulations were performed in a three-dimensional computational domain using steady Reynolds-averaged Navier–Stokes equations and a shear-stress transport k " ω turbulence model. The computational domain was discretized using a hexahedral/tetrahedral mesh with approximately 2.5 million cells. The flow was investigated for the velocity fields, as well as the mean and variance of the axial velocity. The impact of the aspect ratio and bevel length on these parameters was analyzed. The results were found to be in reasonable agreement with the available experimental data in the literature. It was observed that increasing the aspect ratio decreased the length of the potential core; thereby, a corresponding increase in turbulence and mixing was obtained. Again, beveling of the nozzle could significantly change both flow pattern and turbulence structures in the jet, which would make it an effective passive method for jet noise reduction.

Shashi Kumar S, Murugan N & Ramachandran K K, "Microstructure and mechanical properties of friction stir welded AISI 316L austenitic stainless steel joints", Journal of Materials Processing Technology (2018), 254, pp. 79-90. https://doi.org/10.1016/j.jmatprotec.2017.11.015

Abstract: Rolled sheets of 3 mm thick, AISI 316L austenitic stainless steel was successfully friction stir (FS) welded at different tool rotational speeds in the range from 400 rev/min to 800 rev/min with precisely selected constant values of other process parameters (welding speed of 45 mm/min, axial load of 12 kN and tool tilt angle of 1.5°). The microstructural characterization by orientation imaging microscopy (OIM) and transmission electron microscopy (TEM) revealed that discontinuous dynamic recrystallization was the dominant recrystallization mechanism in the stir zone. The grain size of the stir zone was greatly influenced by both heat generation and material strain rate. The shear bands were observed in the weld zone and the intensity of the shear bands was highly influenced by the deformation temperature. The results of the multi-spot energy dispersive spectroscopy (EDS) analysis within the narrow region of the shear bands depict the presence of tungsten traces for all the cases and, the minimal tungsten concentration was found in the weld joint made at 600 rev/min. The non-existence of secondary phases in the weld zone was owing to lower peak temperatures in FS welding. The base steel and the FSW joints depict a stable pitting potential after the activation controlled anodic region and the weld joints had marginally better pitting corrosion resistance than the base steel.

Shashi Kumar S, Murugan N & Ramachandran K K, "Effect of friction stir welding on mechanical and microstructural properties of AISI 316L stainless steel butt joints", Welding in the World (2018), pp.1-14. https://doi.org/10.1007/s40194-018-0621-7

Abstract: Friction stir welding (FSW) was applied for the joining of 3-mm-thick AISI 316L stainless steel sheets. The investigation was aimed to explore the relationship between weld joint characteristics and one of the very important primary FSW parameters, the welding speed. The soundness of the fabricated joints was tested by x-ray radiography technique initially. The microstructural studies of the joints were carried out using scanning electron microscopy (SEM), transmission electron microscopy (TEM) and electron back scattered diffraction (EBSD). The presence of fine equiaxed austenite grain boundaries and the consequent increase in hardness at the weld SZ resulted in joint strength superior to that of the base steel at higher welding speeds. But, at lower welding speeds, the evolution of delta ferrite decreased the toughness and strength of joints owing to higher heat generation (higher peak temperature). However the delta ferrite formed in the weld SZ has not transformed into sigma phase, probably due to the fast cooling of the weld zone.

Ramachandran K K & Murugan N, "Axial force influence on the characteristics of friction stir butt welded aluminium alloy/steel joints", Strength of Materials (2018), 50(6), pp. 346-55.

Abstract: In this work, the effect of axial force on the tensile strength, microhardness, joint interface microstructure and fracture surface morphology of friction stir welded (FSW) dissimilar butt joints of 3 mm thick aluminium (Al) alloy AA5052 H32 and HSLA steel IRS M-42-97 were investigated. The FSW trials were carried out by varying the axial force from 5 – 9 kN while keeping the other parameters constant. The highest joint strength of about 90% of the ultimate tensile strength (UTS) of the base Al alloy is obtained at 7 kN axial force. It is found that axial force in the range, 6 - 8 kN could produce joints with joint strength above 75% of the UTS of the base Al alloy. EDS and XRD analysis suggests that the intermetallic compound (IMC) layer formed at the joint interface is consistent with $FeAl_3$ and FeAl at lower and higher axial forces, respectively. Joint interface analysis shows that the thickness of IMC layer formed at the interface is critical in the performance of the joint and the joints with an average IMC layer thickness of about 1 µm at the joint interface has exhibited the highest joint strength.

Electrical Engineering

Remani T, Jasmin E A & Imthias Ahamed T P, "Residential Load Scheduling With Renewable Generation in the Smart Grid: A Reinforcement Learning Approach", IEEE Systems Journal (2018), 99, pp. 1 – 12.

Abstract—The significance and need of demand response (DR) programs is realized by the utility as a means to reduce the additional production cost imposed by the accelerating energy demand. With the development in smart information and communication systems, the price-based DR programs can be effectively utilized for controlling the loads of smart residential buildings. Nowadays, the use of stochastic renewable energy sources like photovoltaic (PV) by a small domestic consumer is increasing. In this paper, a generalized model for the residential load scheduling or load commitment problem (LCP) in the presence of renewable sources for any type of tariff is presented. Reinforcement learning (RL) is an efficient tool that has been used to solve the decision making problem under uncertainty. An RL-based approach to solve the LCP is also proposed. The novelty of this paper lies in the introduction of a comprehensive model with implementable solution considering consumer comfort, stochastic renewable power, and tariff. Simulation experiments are conducted to test the efficacy and scalability of the proposed algorithm. The performance of the algorithm is investigated by considering a domestic consumer with schedulable and nonschedulable appliances along with a PV source. Guidelines are given for choosing the parameters of the load.

Renuka T K, Reji P & Sasidharan Sreedharan, "An enhanced particle swarm optimization algorithm for improving the renewable energy penetration and small signal stability in power system", Renewables: Wind, Water, and Solar, (2018) 5:6. https://doi.org/10.1186/s40807-018-0053-4

Abstract: In power systems, increasing the renewable energy penetration with small signal stability is one of the demanding and critical tasks in recent days. This research work aims to develop a multistage optimization technique, namely particle swarm optimization (PSO), for improving both the energy penetration and small signal stability. Here, the wind and solar power sources are considered, and its penetration is maximized by satisfying the grid requirements such as the bus voltage, line flows, and real and reactive power generation within the limit. This work includes two stages: in the first stage, PSO algorithm is implemented for maximizing the renewable energy penetration to the test systems. Then, in the second stage, the small signal stability of the systems is improved with maximum renewable energy penetration in which the best locations for connecting the wind farm are identified by using the calculation of wind farm placement index and solar generation is fixed by considering voltage and bus load absorption capability. During simulation, the proposed method is tested and validated by using IEEE 14-bus standard system, and the 220 kV Kerala (India) grid practical system with the solar and wind power. Moreover, various measures such as power generation, load and bus voltage are evaluated for two different case studies. In this evaluation, it is proved that the renewable energy sources are safely integrated with the power system with increased energy penetration and improved small signal stability.

Suhara E M, Nandakumar M & Mathew K "Adaptive hysteresis based multifunctional electric vehicle charger with a single feedback loop controller", The Journal of Engineering (2018), 8, pp. 714-720.

Abstract: The electric vehicles (EVs) have gained popularity over recent years due to the stringent environmental standards on greenhouse emission and the scarcity of fossil fuels. The increased demand for plug in EVs has necessitated grid integrated bidirectional EV battery charging systems. These charging stations deployed near the parking lots, shopping malls or industries can make the EVs suitable for long-distance runs. Moreover, the off-board charging methods with grid integration and proper communication interfaces can utilise the EV to enhance demand side management. This study proposes a multifunctional, grid integrated, bidirectional charger with a single feedback loop controller. Along with the battery charge or discharge control at unity power factor operation, the system can act as an active power filter for the non-linear and reactive loads connected to the point of common coupling. Also, the bidirectional AC/DC converter is operated with reduced switching adaptive hysteresis current controller to assure high efficiency. Analysis of various modes of operation of the system is done using MATLAB/Simulink and the prototype of the low power setup is done with FPGA to validate the concepts.

Renukadevi V, Jayanand B & Sobha M, "A DC DC converter based infinite level inverter as DSTATCOM." International Transactions on Electrical Energy Systems (2018) https://doi.org/10.1002/etep.2724

Abstract: In this paper, a three phase, infinite level voltage source inverter (ILI) topology based DSTATCOM is put forth. The number of voltage levels of an ILI depends on the carrier frequency used. Its reduced harmonic content, high DC link utilization, and reduced THD outweigh other inverter topologies and switching techniques. In the proposed technique, a single high frequency switch alone is needed. The instantaneous reactive power theory is used for the compensation. The aim of this paper is to mitigate harmonics by a new circuit topology for inverter feeding current at the point of coupling which requires lesser dc voltage when compared with conventional bridge type inverter which requires more than 1.5 times the rms voltage of supply voltage as the dc link voltage. The converter models are implemented in the MATLAB/SIMULINK. The power quality performance of the ILI based DSTATCOM is analyzed, and its hardware model is developed.

Electronics & Communication Engineering

Roy Francis & Meganathan D, "A novel DDS architecture for dynamic reconfigurable three phase induction motor drive", Journal of Electrical Engineering (2018), 18(2), pp.136-144.

Abstract: This paper presents a novel Direct Digital Synthesis (DDS) architecture based dynamic Reconfigurable Pulse Width Modulated (RPWM) variable frequency drive. The proposed architecture employs DDS based waveform generator to get a highly stable reference sine wave that reduces the hardware complexity and improves the system robustness. The architecture incorporates two switching strategies - Sine Pulse Width Modulation (SPWM) for lower Total Harmonic Distortion (THD) below 25 Hz and Space Vector Pulse Width Modulation (SVPWM) beyond 25 Hz. The proposed architecture incorporate a simplified dynamic reconfiguration strategy for faster control switching compared to the existing complex dynamic partial reconfiguration algorithms. The proposed method is experimentally validated through a three phase squirrel cage induction motor interfaced with a low cost Cyclone–IITM FPGA. The dynamic reconfiguration strategy achieves a switching speed of 480 ns.

Production Engineering

Ramadas T & Satish K P, "Identification and modeling of process barriers: Implementing lean manufacturing in small-and medium-size enterprises", International Journal of Lean Six Sigma (2018), 67(3), pp. 467-486.

Abstract: This study was conducted to identify the process barriers in implementing lean manufacturing in SMEs. Moreover, by a thorough and detailed analysis, process barriers of high rejection rate, employee absenteeism and frequent breakdown with 29 associated variables were identified as the most critical process barriers and were used to develop the questionnaire. Structural equation modeling was used to build the measurement model by drawing on samples of 128 SMEs in Kerala, a state in India. Later, the model was validated using statistical estimates. Data analysis helps to determine whether to accept or reject the hypothesis on the basis of the measurement model.

Ramadas T & Satish K P, "Identification and Modelling of employee Barriers-Implementing Lean Manufacturing in Small and Medium Scale Enterprises", International Journal of productivity and performance management, (2018). doi.org/10.1108/IJLSS-09-2016-0044

Abstract: The purpose of this paper is to present the factors associated with the employee barriers while implementing lean manufacturing within the small- and medium-scale enterprises (SMEs). The structural equation modelling approach is employed to develop the initial model drawing a sample survey of 133 small and medium enterprises. The result of the study shows that the lack of well-trained and experienced staff, lack of knowledge about existing specialist, cultural resistance to change are acting as the employee barriers while implementing lean manufacturing in SMEs. Then, a further study has been conducted to develop the employee barrier model with these three factors and its contributing variables using specification search.

Ramadas T & Satish K P, "A model to identify the Factors of Supplier Communication and Financial Availability to Support the Lean Manufacturing Implementation in Small and Medium Scale Enterprises", International journal of service and operation management (2018), 31(4), pp. 480-493.

Abstract: The aim of the research paper is to present the factors associated with supplier communication and financial availability that constitute a successful implementation of lean manufacturing within the small and medium scale enterprises. Structural equation modelling (SEM) was employed to test the model drawing on a sample of 124 small and medium scale enterprises (SMEs) Kerala India. Specification search in Amos 20 was employed to find out the best theoretical model given an initial model using the certain fit function criteria. Communication with supplier and financial availability with 16 elements were considered in the questionnaire.

Anand Alex & Sujatha I, "Comparison of Cooling Load Estimation Method by CLTD Method and Android Application", International Journal of Research in Electronics and Computer Engineering (2018), 6(3), pp. 451-454.

Abstract: Rise in the temperature due to global warming and climatic changes increased the importance of air conditioning all around the world. So in the recent years there is an increased demand for heating and cooling technologies. In the past, heat load estimations were done on the basis of professional experience or by using thumb rules. But manual calculations are complex and more subjected to human error. Although computer softwares are available in the market, they are costly and some of them provide free trial versions also. In the age of smart phones which has the same performance of computers, smartphones can also be used as a tool to deliver optimal designs for air conditioning systems. In this paper HVAC toolkit android application is developed for the comparison of result by using ASHARE CLTD method, which verifies the ability of the smartphones to carry out heat load calculation.

Sujatha I & Venkatarathnam G, "Comparison of performance of a vapour absorption refrigeration system operating with some hydrofluorocarbons and hydrofluoroolefins as refrigerants along with ionic liquid [hmim][TF2N] as the absorbent", International Journal of Refrigeration (2018), 88, pp. 370-382.

Abstract: The performance of a vapor absorption refrigeration system (VARS) operating with ionic liquid [hmim][TF$_2$N] and HFC refrigerants R32, R152a and R125 and HFO refrigerants R1234ze(E) and R1234yz has been analysed. The PC-SAFT equation of state is used to estimate the properties of ionic liquid-refrigerant solutions as well as that of pure refrigerants. The effect of absorber, generator, evaporating and condensing temperatures on the coefficient of performance and circulation ratio has been studied. An exergy analysis has been carried out to understand the major sources of losses in different components. The results show that the performance of a VARS with [hmim]TF$_2$N] and HFC refrigerants R32 and R152a is better than that with [hmim]TF$_2$N] and HFO refrigerants R1234yf and R1234ze(E). The results of this study show that ionic liquid-low GWP refrigerants R32/R152a combinations are suitable for use in vapor absorption refrigeration systems for air conditioning applications.

MCA

Ali M A & Jasmin E A "Adaptive modulation and interference cancellation techniques for MIMO-OFDM wireless networks", International Journal of Networking and Virtual Organizations (2018), 18(3), pp. 246-264.

Abstract: MIMO-OFDM is one of the most wanted wireless broadband technology and transmission systems that has been accepted as the basis of fourth generation (4G) wireless communication. In order to overcome the Doppler shift and associated issues, an adaptive modulation and interference cancellation technique for MIMO-OFDM wireless network are proposed. Doppler assisted channel estimation method is used to estimate the channel. Also, inter channel/carrier interference (ICI) cancellation scheme is used to integrate the parallel interference cancellation together with the decision statistical combining (PIC-DSC) module to detect the data and transmit it to the estimator to iteratively refine the channel and give interference free channel.

Abstract: The promising capacity and data rate brought by massive MIMO communication systems leads to consider it as the prominent fifth generation mobile technology. Pilot contamination is identified as the most significant impairment that limits the exploitation of its optimum capacity. To mitigate this issue, a partial reuse strategy for of pilot sequences among users in the adjacent cells that are close to the base station (BS) is proposed. A multi factor social spider optimization algorithm (MSSOA), which imitates the cooperative behavior of social spiders, is used for selecting the eligible users for this pilot reuse in neighboring cells.

Chemistry

Abstract: Investigations were carried out to compare the effectiveness of compounds like sodium nitrite, trisodium citrate (TSC) and TSC-zinc acetate to inhibit the corrosion of steel rebar in simulated concrete interstitial solution contaminated with chloride and to explain the mechanism of corrosion inhibition on reinforcing steel by these systems. Inhibition efficiency of these systems was studied by electrochemical techniques such as potentiodynamic polarization and half cell potential measurements. Surface analysis was conducted by FT-IR spectroscopy and optical microscope. When comparing with sodium nitrite, TSC in the presence and absence of zinc acetate displayed good corrosion inhibition efficiency.

Abstract: Prolonged corrosion inhibition response of Sodium Lauryl Sulphate (SLS) on steel reinforcement in contaminated concrete was investigated by gravimetric method and electrochemical techniques such as potentiodynamic polarization and electrochemical impedance spectroscopy. Using half cell potential measurements probability of steel reinforcement corrosion was monitored for a period of 480 days. FTIR spectroscopic analysis of the corroded products deposited on the steel reinforcement revealed the mechanism of corrosion inhibition. Modification in the surface morphology of steel specimens in the concrete was examined by optical microscopy. During the period of investigation (480 days) SLS showed appreciable corrosion inhibition efficiency on the steel reinforcement in concrete.

Dear Colleagues,

GECT Research Bulletin is a bimonthly news bulletin of GEC Thrissur, intended to publish research activities of Students and Teachers. Kindly send the details of your research activities (listed below) to the e-mail address gectresearchbulletin@gectcr.ac.in at the earliest.

- Publications of faculty/staff/students in International/National Journals/Conference proceedings (Article title, Authors' names, Journal name, volume, issue, page number and abstract)
- Awards/achievements of faculty/staff/students in Research and Development activities
- Award of project funding/grants from external agencies
- Achievements of GECT Innovation centre
- Articles on latest research trends and contribution to book chapters by faculty/staff/students
- Faculty/staff/students who acquire Ph. D degree

N.B: Due to the lack of space, some of the news items were not included in the present issue.
We will certainly take up those in the following one.

- Editors