

### Major Findings of Completed Projects Under ARMREB

|   | Title of Project   | Institution           | Date of sanction | PDC (in years) | Cost (Rs in Lakhs) | Major Findings   |
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|   | 1  | 2                     | 3                | 4              | 5                  | 6  |
| 1 | Analysis of Projectile impact problems                     | AMU, Aligarh          | 22-Mar-99        | 3 years        | 4.31               | Modeling and simulation for the three-dimensional non-linear finite element analysis of RC and plain concrete targets under impact load was carried out. Developed model is capable for predicting crackings of concrete and yielding of steel.  |
| 2 | Gun Internal Ballistics studies for SFRJ                   | IIT, Madras           | 23-Mar-99        | 2 years        | 3.4                | Modelling of internal ballistics for SFRJ projectile with respect to the sensitivity of thrust time profile to parameters like propellant nature, flight altitude was carried out.   |
| 3 | Computer simulation of projectile impact on plates         | IIT (Delhi)           | 30-Jun-99        | 2 years        | 15.6               | Constitutive relations for modeling the mechanical properties of the metal plates was developed. A fully functional experimental set-up was established at IIT (D). Developed model and software may be used to analyze a variety of impact situations.  |
| 4 | Computational modelling of some Armament related systems   | IPR, Bhat Gandhinagar | 30-Jun-99        | 2 years        | 18.08              | Two dimensional hydrodynamic computer codes were developed and validated at IPR for modeling explosive-metal interactions and shock initiation of explosives and installed at TBRL. These codes are useful to handle explosive metal interactions and high-velocity impact problems. Simulation of codes was also carried out successfully at IPR. |
| 5 | Design & Development of Integrated Active Circular Antenna | SAMEER Mumbai         | 30-Jun-99        | 18 months      | 9.9                | One unit of "Integrated Active Circular Antenna" was designed and handed over to ARDE alongwith design document/technical know-how.  |
| 6 | Development of Explosive Pulsed Power Generator            | IPR, Bhat             | 31-Aug-99        | 2 years        | 15.78              | Model developed and validated at TBRL  |

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| 7  | Synthesis Characterisation and Evaluation of Azido Polymers as High Energy Binders   | IIT (Delhi)                 | 29-Dec-99 | 2 years   | 17.5  | Polyallyl azides having molecular weight ranging from 850 to 3800 were synthesized. Dipolarophiles like ethylene glycol dimethacrylate (EGDMA) and bisacrylamide were evaluated as curative to obtain a cross-linked polymer network having optimum combination of flexibility and number of azido groups in the binder. The polymer offers a means to augment energetic of propellants/explosives and has potential of application after optimization trials.  |
| 8  | Technology Development of Ferrocene Grafted HTPB and synthesis & performance Evaluation of Burn Rate Modifier Compatible with Fuel binder Binder of HTBP Propellants | MRC RD University, Jabalpur | 24-Mar-00 | 3 years   | 20.78 | A high potential BM Fe(III) 12-hydroxy-oleate (FTHO) synthesized and evaluated in composite propellants. The compound can be used for specific propellants after large-scale evaluation.  |
| 9  | Neural Network Modelling of Range Performance of Armament Stores   | IIT, Kanpur                 | 27-Jun-00 | 2 years   | 6.2   | Neural models have been developed for performance prediction of shells and rockets (Range, Elevation, Drift) under given atmospheric conditions.  |
| 10 | Modelling of Plasma Propellant Interactin for Projectile Acceleration  | IISc, Bangalore             | 3-Jul-00  | 2 years   | 4.2   | Code developed for modelling plasma-propellant interaction for projectile acceleration.   |
| 11 | Dev of new Procedures for Determination of Exploise of Trace Levels by Adsorptive Square wave Stripping Voltametry   | Alagappa University         | 20-Jul-00 | 24 months | 8.2   | A method for voltammetric determination of HEMs was established. The set-up comprises of computerized electro-chemical instrument having software interfaced with a fast digital function generator, high speed data acquisition circuitry, potentiostat and galvanostat. The effect of scanned potential and amplitude was studied. Characteristic patterns for explosives like RDX, HMX, TNT and TATB were obtained. The system offers rapid means of estimating / detecting explosives directly from effluent. |

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| 12 | Design, Evaluation & Synthesis of High Energy Polynitropoly-Cyclic Cage Compounds               | NCL, Pune                    | 29-Aug-00 | 3 years   | 24.5 | Synthesis of TNAZ at gramme level by devising reaction route capable of offering relatively higher yields than reported methods was established.  |
| 13 | Development of Computer Code for Modelling of Optimising EFP Design with Parabolic Lines        | IPR, Bhat Gandhinagar Gujrat | 12-Sep-00 | 10 months | 3.66 | Simulations studies undertaken and validated by experimentation to get a reasonable match with (ARDE) data. Co-relation with respect to liner material established.   |
| 14 | Synthesis and hydroxy terminated Poly-butadine-poly (GA) co-polymers as new high enegry binders | SK Univesity Ananthapur      | 6-Nov-00  | 2 years   | 6    | Aim was to synthesize GAP and convert it to HTPB GAP co-polymer using commercially available HTPB to achieve a combination of high energy and superior strain capability. During review decided to use GAP synthesized at HEMRL to obtain the co-polymer. Problem was experienced in realizing reported catalyst ACPC (4-cyano pentanoyl chloride) from ACPA. As an alternative, N-methyl-2-chloro-pyridinium-iodide was synthesized to realize GAP macro-initiator leading to co-polymerization with HTPB. |

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| 15 | Formulation of ammonia Perchlorate Propellants with Plateau/Biplatue Burning rate Trends | IIT Madras                | 14-Nov-00 | 2 years   | 9.8  | AP-HTPB system was established for achieving low-pressure exponent/plateau burning-a rare phenomenon in composite propellants. Such systems offer edge over commonly used composite propellants. An interesting observation was that isophorone di-isocyanate (IPDI) is a preferable curative to TDI for such phenomena to occur. Experiments undertaken on mid-pressure extinction pattern and revealed that AP(5m)-HTPB (60/40) and (65/35) combinations show extinctions in 3.5-11 and 4-8 MPa region respectively. AP(20m)-HTPB in (60/40) combination gave extinction in 4-10 MPa region. Fine AP/HTPB in (55/45) combination showed extinction at 6 and 8 MPa. It was observed plateau/bi-plateau behavior on combining 315-550m AP with fine AP-HTPB system. This study opens avenue to realize plateau/low pressure exponent burning composite propellants. The work can be extended to aluminized propellants. |
| 16 | Design and Development of Integrated Digital Mocrowave Receiver                          | SAMEER Mumbai             | 21-Nov-00 | 2 years   | 23.7 | Successfully demonstrated demodulation of FM & AM using evaluation board. Application of the out come may be used for design of digital receiver for any radar/missile  |
| 17 | Air Driven Alternator  | HBL Nife PS Ltd Hyderabad | 4-Jan-01  | 18 months | 9.8  | A unit of air driven alternator was assembled and tested at various velocities at the wind tunnel test facility of DRDL Hyderabad. Test results were found satisfactory.  |

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| 18 | Synthesis and Characterisation of Energetic Polymers for Composite Solid Propellants | IISc, Bangalore    | 14-Jan-01 | 20 months | 3.29 | A series of energetic hydroxyl terminated N-N bonded polymers {N,N' (3-azido 2-hydroxypropyl)(bisfurfuraldehyde thiocarbonohydrazone) [FTCHAZ], N,N' (3-azido 2-hydroxypropyl)(bisbenzaldehyde thiocarbonohydrazone) [BTCHAZ], N,N' (3-azido 2-hydroxypropyl)(bisvanilin thiocarbonohydrazone) [VTBHAZ], N,N' (3-azido 2-hydroxypropyl)(bisfurfuraldehyde carbonohydrazone) [FCHAZ], N,N' (3-azido 2-hydroxypropyl)(bisbenzaldehyde carbonohydrazone) [BCHAZ], N,N' (3-azido 2-hydroxypropyl)(bisvanilin carbonohydrazone) [VCHAZ], N,N' (3-azido 2-hydroxypropyl)(bisacetone carbonohydrazone) [ACHAZ]} were synthesized. The compounds were characterized and subjected to thermal analysis. The polymer exhibited thermal decomposition with peak maxima in the range of 200-220°C. The theoretical flame temperature of energetic polymer based compositions ranged from 1600 to 3000°C. Theoretical calculations of rocket propellant based on FCHAZ in comparison to that of CTPB based system revealed improvement in performance. The polymer can be considered for application as binder after undertaking |
| 19 | Sensitivity analysis of FMCW Height Sensing Systems                                  | MBT Pune           | 31-Jan-01 | 8 months  | 20.5 | A library of RF component models of UVT fuze developed. A facility for carrying out sensitivity analysis for sensitive output parameters also established.  |
| 20 | Beam Shaping using Phase only mask at Fractional Fourier Transform Plane             | Kolkata University | 7-Feb-01  | 18 months | 8.41 | Base technology was established for design and synthesis of optical phase only masks capable of generating a laser beam when placed at the fractional fourier transform plane   |

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| 21 | Development of laser based flash Shadow Photographic System for Terminal Studies of Small Arms and Ammunitions (SAA)             | CSIO                | 16-May-01 | 2 years   | 22.66 | System was developed to study detonics characteristics of small caliber projectiles including their effects of impact on targets and installed at TBRL range.  |
| 22 | Study to develop lithium Intercalated carbon electrodes and assess its property for high voltage lithium cells                   | Algappa University  | 29-Jun-01 | 18 months | 8.44  | Indegenious carbon electrodes was developed which may finds applications for the energy density lithium battery system.  |
| 23 | Assessment of working environment exposure in the handling of explosive/ non explosive chemicals for remddial measures           | LMRC, Pune          | 26-Jul-01 | 1 year    | 6.5   | The extent of exposure to toluene di-isocyanate (TDI) and nitroglycerine was evaluated in the propellant processing facilities. The samples collected from the environment were analyzed by HPLC and results were analyzed with respect to Short Term Exposure Limit (STEL) and Chronic Time Weighed Average (TWA) of TDI and NG. The working environment and existing measures were assessed. |
| 24 | Synthesis of AluminiumMatrix Composites using solidification process for Armour Applications                                     | RRL Bhopal          | 12-Sep-01 | 2 years   | 13.67 | Synthesis was carried out to examine the possibilities of using aluminium alloy-SiC composite for armour applications.   |
| 25 | Model for Detonation of Energetic Materials and Orientation Sensitiviey of shock Initiation                                      | Punjab University   | 29-Oct-01 | 30 months | 5.35  | Study of micro-mechanics of shock-initiation of energetic materials undertaken and diagnostic tools to compute pressure and temperature developed.   |
| 26 | Modeling, Simulation & Charaterisation of Silcon based Submicron Semiconductor devices for devices for higher design reliability | University of Delhi | 9-Jan-02  | 36 months | 19.9  | Modelling and simulation of silicon based sub micron devices for higher design reliability of equipments was carried out.  |
| 27 | Study, analysis and implementation of DSP algorithm for FMCW Height Sensing System   | M/s MBT, Pune       | 9-Jan-02  | 8 months  | 19.87 | Algorithm was developed to address the signal to noise ratio of -20 dB and selection of optimal hardware device to meet the design constraints and implementation of DSP algorithm on TMS320C5402 DSP was carried out. End-to-end validation and implementation of algorithms was also done.   |

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| 28 | Electrodeposition of Magnetic Multilayers with High Giant Magnetoresistance                                 | IIT, Kanpur              | 27-Sep-02 | 3 years   | 9.56  | Electro deposition of data storage and sensor grade magnetic multilayers with high giant magnetoresistance was carried out.   |
| 29 | PZT Thick Film Actuators  | C-MET, Thrissur          | 8-Oct-02  | 2 years   | 9.41  | Piezoelectric thick film actuator using screen printing method on alumina substrates was developed.   |
| 30 | Development of Novel Class of Materials for Antenna having Automatic Beam Steering Property                 | Cochin University        | 8-Oct-02  | 36 months | 9.58  | Prepared polyaniline and poly-pyrrole composites with PVC for the development of an antenna having automatic beam steering property.  |
| 31 | Computation of flows around discarding sabot using CFD technique  | IIT, Kanpur              | 19-Feb-03 | 18 months | 8.05  | Study on grid generation and estimation of flow properties around projectile and sabot at various Mach number was carried out.  |
| 32 | Aerodynamic parameter estimation of artillery projectiles from radar tracked flight data                    | IIT, Kanpur              | 20-Feb-03 | 2 years   | 7.08  | Methods based on MLE (Maximum Likelihood Estimator) and Kalman Filter for the estimation of drag coefficient from radar tracked data and its dependencies on Mach number has been established |
| 33 | Development of nitration methodology including microwave mediated approaches for synthesis of advanced HEM. | NM University, Jalgaon   | 7-Apr-03  | 2 years   | 4.99  | Microwave technique established for nitro compounds and eco-friendly nitration approach.  |
| 34 | Studies of high performance insensitive explosives  | DDU Gorakhpur University | 23-Apr-03 | 1 year    | 5.93  | Tetrazolates synthesized. The compounds exhibit high decomposition temperature.   |
| 35 | Up-gradation of trisonic wind tunnel facilities   | IIT, Kanpur              | 25-Apr-03 | 2 years   | 22.84 | Up-gradation of the existing tunnel was carried out for simulation studies.   |

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| 36 | Synthesis, characterization & evaluation of dendritic azido polymers as high energy binders/plasticizers | IIT, Delhi               | 14-May-03 | 1 year   | 5.74 | Potential curatives 1,4-bismaleimide butane, 1,6-bismaleimide hexane, 1,8-bismaleimide octane, 4,4'-bismaleimide diphenyl ether, 4,4'-bismaleimide diphenyl sulfone, 1,4-bisitaconimides butane, 1,6-bisitaconimides hexane, 1,8-bisitaconimides octane, 4,4'-bisitaconimides diphenyl ether, and 4,4'-bisitaconimides diphenyl sulfone at 40 g batch level was synthesized. 1 kg of poly (allylazide) and 100 gm of selected bismaleimide curative was also synthesized. Exhaustive curing studies carried out and synthesis of dendritic azido-derivative having 70-80% oh of precursor replaced by -N <sub>3</sub> group established. |
| 37 | Organophosphorus polymeric additives for rocket propellant inhibitor/liner applications                  | Anna University, Chennai | 14-May-03 | 2 years  | 7.2  | The six polymers poly[4,4'-diphenylhexyloxy isopropylidene(6-bromohexyl phosphate ester)], poly[4,4'-diphenylhexyloxy isopropylidene(4-chlorophenyl phosphate ester)], poly[4,4'-diphenylhexyloxy isopropylidene(4-bromophenyl phosphate ester)], poly[4,4'-diphenylhexyloxy sulphone(6-bromohexylphosphate ester)], poly[4,4'-diphenylhexyloxy sulphone(4-chlorophenyl phosphate ester)], poly[4,4'-diphenylhexyloxy sulphone(4-bromophenyl phosphate ester)] were synthesized and characterized by the PI. The polymers are under investigation as component of inhibition/binder formulation.   |
| 38 | Wide band antenna and RF front end for transreceiver module  | SAMEER, Mumbai           | 26-May-03 | 6 months | 10   | Technology demonstration of bench prototype trans-receiver module with wide band antenna was carried out. Extraction of beat frequency signal corresponding to+ 9m/- 4m height achieved.   |
| 39 | Effect of weld metal mismatch on fatigue and fracture toughness behaviour of armour steel joints         | Annamali University      | 02-Jun-03 | 3 years  | 9.97 | Welded joints fabricated and evaluation on base metal and weld metal was carried out. Study also carried out on effect of strength mismatch and microstructure mismatch of weld metals on fatigue and fracture behaviour of armour steel.  |



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| 40 | Low and medium velocity impact of projectiles on laminated plates                                  | IIT, Chennai         | 01-Jul-03 | 3 years   | 14.83 | Study carried out on a low velocity projectile impacts and impact data generated for various projectiles.                              |
| 41 | Development of simulation driven design tools for efficient armour design                          | IISc, Bangalore      | 14-Aug-03 | 3 years   | 5     | Criteria and numerical procedures for designing penetration resistant armour was developed   |
| 42 | Characterization of nano aluminium powder for combustion in solid propellants                      | IIT, Chennai         | 3-Dec-03  | 2 years   | 9.48  | Technology established for production of nano aluminium particles by using pulse energy technology                                     |
| 43 | Two dimensional simulation of slapper detonators   | IPR, Gandhinagar     | 3-Dec-03  | 1 year    | 8.61  | 2-D code was developed to model slapper detonation technique and was validated.  |
| 44 | Plasma Antenna for Communication and radar   | Behrampur University | 4-Dec-03  | 3 years   | 3.09  | Theoretical investigation of various technical aspects of the plasma antenna was carried out   |
| 45 | Design and development of 50 KJ electrical pulse demonstrator compulsator                          | IISc, Bangalore      | 31-Dec-03 | 1 year    | 23.59 | Technology for 50 kJ electrical pulse compulsator was developed.   |
| 46 | Design of metal selective chelating polymers for use in explosives                                 | Delhi University     | 29-Apr-04 | 1 year    | 3.24  | Aluminium selective chelating polymers for use in explosives were designed.  |
| 47 | Development of technology for recovery, reuse, safe & ecofriendly disposable and common explosives | Pune University      | 29-Apr-04 | 1 year    | 6.1   | Eco-friendly method to recover explosive from the formulations obtained from discarded, rejected, and expired ammunitions established. |
| 48 | Synthesis of polynitro compounds promising HEM   | Pune University      | 23-Jul-04 | 14 months | 8     | Synthesis and characterization of polynitro compounds was carried out.   |
| 49 | Feasibility study of nanoaluminium in HTPB and DOA Matrix  | Pune University      | 18-Aug-04 | 1 year    | 7.22  | Feasibility study of synthesizing nano phase powder of aluminium by thermal plasma reactor carried out.                                |
| 50 | Feasibility study of Antijam GPS receiver for GPS guided weapons                                   | IIT, Kharagpur       | 15-Sep-04 | 18 months | 9.7   | Study carried out on various methods used for anti jam GPS and summaries their relative merits and demerits.                           |
| 51 | Dev of ANN based propagation models for Mobile communication                                       | NIT, Rourkela        | 27-Oct-04 | 2 years   | 9.37  | Theoretical investigation carried out on various technical aspects of propagation models for mobile communication.                     |

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| 52 | Preparation of superhard nanocomposite coatings of transition metal nitrides                                       | IIT, Roorkee                          | 30-Dec-04 | 2 years   | 9.97  | Technology for nanophase coatings to improve thermo-mechanical properties of inner surface of the Gun Barrels was developed.  |
| 53 | Aerodynamic study of Lattice Fins using wind tunnel testing for high angle of manoeuvre of strategic aircraft bomb | IIT, Kanpur                           | 18-Mar-05 | 2 years   | 9.37  | Study on aerodynamic characteristics of lattice fins and its effect at high angle of attack manoeuvre and its feasibility to strategic mission and wind tunnel tests carried out  |
| 54 | Study on trajectory correction system using impulse jet to reduce the impact point dispersion                      | IIT, Kanpur                           | 21-Mar-05 | 2 years   | 8.11  | Methodology to reduce the impact point dispersion of the fired rocket using in-flight pulse jet control system formulated.  |
| 55 | Development of High efficiency and high density electric power conversion system                                   | CEERI, Pilani                         | 22-Mar-05 | 2 years   | 9.97  | Using direct AC-AC power conversion based on matrix converter technology the over all weight and size is reduced by 20-30% of conventional AC-DC-AC power conversion system   |
| 56 | Benchmark experiment on confined and unconfined explosive driven shock propagation                                 | IISc, Bangalore                       | 22-Mar-05 | 2 years   | 9.77  | Experimental database developed on shock wave propagation, attenuation and reflection characteristics in both confined and unconfined domains for computational fluid dynamic (CFD) code validation studies                           |
| 57 | Studies on performance and process parameters for bulk micromachining of microsensors for armament applications    | Pune University                       | 19-May-05 | 2 years   | 9.95  | Process developed successfully for bulk micromachining of microsensors for armament application   |
| 58 | Environment detection assessment and response system   | PSG College of Technology, Coimbatore | 19-Jul-05 | 18 months | 13.73 | Subsystem of a mobile robotic platform for detection and source point tracking of firearm shots, recognition of the firearm based on its audio signature and transmission of the information to mission command centre was developed. |
| 59 | Design and development of wide band micro strip antenna for s/c band   | IT, BHU                               | 19-Jul-05 | 2 years   | 27.12 | Printed circuit antenna for wide band operation was developed.  |
| 60 | Microwave Remote Sensing for Buried Object Detection and its Shape Recognition                                     | IIT, Roorkee                          | 21-Jul-05 | 2 years   | 9.27  | Study carried out only to X-band, with moisture content 10-15 % and simulation were done for rough surface.   |

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| 61 | Development of Automatic Target Detection Algorithms using Multi-resolution techniques | Mepco Schlenk Engineering College | 21-Jul-05 | 2 years   | 9.98  | Software was developed for detecting the man made targets using various multi resolution techniques to explore the possibility of using these techniques in identification of targets/objects having linear/circular geometry in the optical images receive by the satellite or Milli Meter Wave (MMW) images. |
| 62 | Survivability of plate/shell panel structures/structural components under impact loads | SERC, Chennai                     | 28-Jul-05 | 2 years   | 14.9  | Criteria was developed to assess damage of the structures under impact load and conducted numerical investigations for damage assessment of plate/shell panel structures for survivability.  |
| 63 | Plasma Arc Data Generation for ETC Cartridge Design                                    | IISc, Banagore                    | 23-Aug-05 | 15 months | 22.64 | Experimental data generated on plasma arc to facilitate the design of plasma cartridge for use in ETC gun.   |

**Major Findings of Completed Projects Under ARMREB**

| S.No. | Title of project   | Institution                    | Date of Sanction | PDC (in years) | Cost (Rs in lakhs) | Major Findings   |
|-------|--|--------------------------------|------------------|----------------|--------------------|--|
| 64    | Simulation Studies on Doped Polycrystalline Pressure Sensors   | IT, BHU, Varanasi              | 23 Aug 05        | 2 Years        | 22.43              | A pressure sensor, based on piezoresistive principle employing polysilicon over single crystal silicon material for measurement of high pressure transients have been design and subsequently simulations of the sensor were carried out to study the static and dynamic responses of the sensor. The measurement pressure range of the sensor observed upto 500 MPa with good linearity and having sensitivity of 750 mV/V/F.S. The fundamental frequency of the sensor was 5.91 MHz, which is manifolds higher than the highest frequency component of transients. The frequency response of this sensor was observed to be flat upto 3 Mhz and continued to be almost flat uo to 5 Mhz. |
| 65    | Amorphous Carbon-Polymer Composites for EMI Shielding and ESD Applications   | IISc, Bangalore                | 23 Aug 05        | 2 Years        | 18.49              | Conducting nanoparticles polymer composites prepared and EMI as well as ESD measurements done for these composites. These films can be used as EMI gaskets for RF circuits and assembly.   |
| 66    | Development of Smart Materials Based on Phase Transformation and Domain Polarization for use as Pressure-Sensitive Switch in Armament Applications | CEERI, Pilani                  | 1 Sep 05         | 2 Years        | 9.94               | Doping in smart materials examined from the point of view of doping and coating mechanisms. Pallet formation and coating as well as thick-film and thin-film techniques have been examined. Although pallet formation and coating are simpler techniques but thick-film and thin-film techniques yield better results. A software program was developed for achieving the desired electromechanical properties. The present work will help to develop new and improved smart materials.  |
| 67    | Use of composites for high speed rotor construction for pulse power applications   | RV College of Engg., Bangalore | 1 Oct 05         | 2 Years        | 18.55              | Construction performance test of the composite rotors for pulse power generator with different parameters such as filament winding angle, number of poles, speed of shaft by using finite element analysis successfully conducted.   |
| 68    | ASIC Control for AC Servo Motor Drive for Military Applications  | RV College of Engg., Bangalore | 14 Oct 05        | 2 Years        | 9.98               | A servo motor controller that caters to a variety of military applications was conceptualized and designed and the same was simulated on ModelSim Software, and the waveforms relevant to each applications were produced and verified for accuracy.   |
| 69    | Studies on High-Power Microwave Devices for Directed Energy Weaponry   | IT, BHU                        | 20 Oct 05        | 2 Years        | 9.90               | Feasibility study on high power microwave (HPM) sources for armament application as Directed Energy Weapons (DEW)  |

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| 70 | Development of Human Powered Electrical Generator for Portable Electronic Equipment   | CEERI, Pilani                  | 27 Jan 06 | 2 Years | 8.00  | A very simple analytical solution developed for generalized design of the magnetic spring based vibration generator, simple analytical human walk model has been developed. The vibration generator is tested with ultra low voltage/low power multivibrator to demonstrate its application.  |
| 71 | Development of Computational Model and Simulation for Optimization of Penetration of Segmented Projectiles using Hydrocodes | RV College of Engg., Bangalore | 2 Feb 06  | 2 Years | 8.90  | The work carried out under the project help to study the effect of offset on the performance of segmented penetrators, optimize the L/D and S/D ratioon the performance of multiple segment trains and to study the effect of moving target on the performance of segmented penetrators.  |
| 72 | Laser Assisted Deposition of Thermal Barrier Coatings on Missile Casings  | RV College of Engg., Bangalore | 13 Mar 06 | 2 Years | 9.97  | Thermal Barrier Coatings with Ti6 substrates, Nickel-Chromium-Al-Yttrium bond coat and YSZ top coat were fabricated using Plasma Spray technique. The coatings were laser glazed using CO <sub>2</sub> laser and evaluated for thermal gradient and coating properties. Conductive and convective heat transfer experiments showed significant increase in thermal gradient between the top coat and the substrate.   |
| 73 | PZT Microactuators  | C-MET, Thrissur                | 28 Apr 06 | 2 Years | 14.72 | <ul style="list-style-type: none"> <li>• Fabrication of PZT microactuator successfully completed.</li> <li>• The dielectric and piezoelectric characteristics of the micro actuator were determined and were found to be better than the targeted specifications.</li> <li>• Achieved a transverse piezoelectric coefficient e<sub>31</sub> of -3.00 C/m<sup>2</sup> against the targeted value of -0.4C/m<sup>2</sup> and exceeded target specification of the Microactuator.</li> </ul> |
| 74 | Design optimization of 50KJ compulsator   | IISc, Bangalore                | 4 Jul 06  | 1 Year  | 9.98  | 1 ton mass reduction of the compulsator, pulse upto 150 kJ, peak currents 100 kA, Bavg about 1 wb/m <sup>2</sup> acheived   |
| 75 | Studies on odour sensors and discrimination techniques– an approach to E-nose   | CET, Moradabad                 | 7 Nov 06  | 2 Years | 21.94 | Establishment of technology through fabrication and testing of explosive gas detector was reported  |

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| 76 | Synthesis and Analytical Application of Polynitrate Macro-Cycles as Chemical Sensor                              | IIT Roorkee                                  | 15 Dec 06 | 3 Years   | 9.96  | Macrocyclic complexes I, II and III were synthesized which were found to be responsive to phosphate, iodide and bromide ions. Macrocycles IV, V, VII, VIII, IX (a and b), XI (a and b), XII (a and b) were found to be selective to Hg(II), Co(II), Zn(II), Gd(III), ni(II), TB(III), Yb(III), Co(II) and Ce(III) respectively. The real sample analysis was carried out using coated graphite electrode in case of membrane containing IX, X, XI and XII as electroactive components as it gave the better response characteristics w.r.t working concentration range, response time, slope, detection limit and selectivity over other metal ions in comparison to polymeric membrane electrode. All the membrane sensors developed have been used as indicator electrodes in the potentiometric titration of respective metal ions. The practical utility of these sensors has been tested by carrying out the determination of these metal ions in real samples. |
| 77 | Design of high energetic materials via experimental electron density method                                      | Periyar University                           | 26 Feb 07 | 1 year    | 6.58  | Study to understand and characterize the bonds of the RDX molecule in terms of topological and electrostatic properties and to identify weak and strong bonds which helps to predict the initial bond break of explosive molecules. The crystal density from the experiment enables to predict the explosive power.  |
| 78 | Green Chemistry approach for the synthesis of high molecular weight energetic polymers over solid acid catalysts | Manonmaniam Sundaranar University, Tamilnadu | 22 Jan 08 | 2 Years   | 8.00  | A new viscous gel form of polyepichlorohydrin (PECH) has been synthesized in this project, with lower molecular weight (Mn=924) and the energy more than the conventional PECH.  |
| 79 | Development of 1 kj ETC cartridge prototype  | IISc, Bangalore                              | 28 Jan 08 | 18 Months | 22.45 | ETC plasma cartridge was successfully designed, developed and tested. mathematical modeling of ETC cartridge developed, role of different cartridge studied, propellant ignition tests performed, acoustic ignition from plasma measures for the 1st time and image analysis of plasma conducted.  |
| 80 | Development of Non Lead Perovskites for Device Applications  | TM Bhagalpur University, Bhagalpur           | 1 Feb 08  | 3 years   | 9.85  | Various Non-lead perovskites were designed and studied.  |
| 81 | Synthesis of novel siloxane and carbosiloxane sorbents for explosive sensors                                     | IICT, Hyderabad                              | 17 Mar 08 | 3 years   | 24.99 | Under this project work, several novel hexafluoroisopropanol functionalized siloxane polymers, which are structurally similar to SXFA have been designed and synthesized. Also developed a new process route for SXFA, which has wide applications as sorbent in chemical sensors.   |
| 82 | An investigation on the detection of electron deficient aromatic compounds : design, synthesis and study         | Vidya Sagar University                       | 12-Aug-08 | 1 year    | 5.86  | A new technique for the visual detection of aromatic explosives was invented.  |

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| 83 | Design and Development of Landmine Detection System using Wireless Sensor Network for Military Applications             | Avinashilingam University for women, Coimbatore | 17-Oct-08 | 2 Years | 13.24 | The developed system provided 100% detection rate. So it can be used in military by integrity the system in unmanned tank for identifying the landmines. The wireless sensor techniques can be integrated with any vehicle and the software based detection system can be fully utilized by the military. The facilities created in the project are the hardware set up: Personal Computers and IR Camera and Software Tool MATLAB libraries.   |
| 84 | Process Development of super-capcitive model (>500 F/g) using polyaniline multielectrodes                               | Shivaji University, Kolhapur                    | 17-Oct-08 | 2 Years | 24.91 | Fabrication of different super-capcitive model (>500 F/g) using polyaniline multielectrodes and their individual performance test using charge-discharge studies to calculate power density, energy density etc has been carried out successfully.  |
| 85 | Adaptive Texture Representations Methods for Automatic Target Detection using Neural Network                            | RV College of Engineering, Bangalore            | 20-Oct-08 | 2 Years | 9.96  | Robust detection of foreground object for different types of video can correctly handle scenes containing: Moving object, gradual illumination variation, can detect multiple foreground objects, complex background  |
| 86 | Design and Evaluation of different control strategies for upgrading existing aircraft bombs to guided bombs             | Indian Institute of Technology, Kanpur          | 11-Nov-08 | 2 Years | 18.20 | Guided projectiles were launched from a height of 1000m and range achieved due to different configurations was observed. The maximum range that is obtained during the trajectory simulation is 6042m which is associated with body + strekes + Nosefins + tail fins deflection of -10 degree   |
| 87 | Synthesis and characterization of Alumium metal matrix functionally graded armour materials reinforced with zircon sand | Thaper University, Patiala                      | 22-Jan-09 | 3 Years | 20.00 | <ul style="list-style-type: none"> <li>• Developed the zircon sand reinforced aluminum matrix composite with optimize wear resistance.</li> <li>• By developing the hybrid composite (combination of zircon sand particles reinforced Al- matrix composite with copper messes), residual velocity of bullet (AK-47) was reduced upto 65%.</li> <li>• Developed hybrid composite was able to reduce the velocity of bullet from 710 m/s to 268 m/s fired from 10 meter distance. Hence, this material can be used against the light velocity ballistic impact test.</li> </ul> |

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| 88 | Design of High Energetic Materials : A combined Molecular Modelling and electron Density Analysis Approach                    | Periyar University, Salem                            | 22-Jan-09 | 3 Years | 22.75 | <ul style="list-style-type: none"> <li>• Quantum chemical calculation, crystal density prediction and charge density analysis of several known molecules have been carried out. The predicted density of the molecules has been validated, which are well match with the corresponding reported experimental structures.</li> <li>• Crystal structure, crystal density and charge density distribution of the some nitrogen rich experimentally unknown molecules were predicted.</li> <li>• A computational method has been developed to design high energetic molecules.</li> </ul> |
| 89 | Development of Soft Magnetic Materials from Nano Dispersion of Magnetic Particles for High Frequency Applications             | IIT, Kharagpur                                       | 2 Sep 09  | 3 years | 36.56 | <p>(a) Developed powder nanocrystalline high frequency sensor material. Developed a capability to measure ac magnetic parameters of under low applied fields and frequencies upto 20 kHz.</p> <p>(b) The material will be used for development of magnetic and frequency sensor.</p> <p>(c) These sensors will find application for detection of low magnetic fields i.e., detection of small change in magnetic field due to movement of tanks / vehicles.</p>   |
| 90 | Development of Low-Cost remote Health Monitoring System for civil/ Mechanical/Aerospace Structures using Piezoceramic sensors | Indian Institute of Technology, Hauz Khas, New Delhi | 26 Feb 10 | 2 Years | 9.58  | <p>a) The new developed damage detection algorithm for 1D structure (beams) and 2D structures (plate like defense structure) can be utilized for non destructive evaluation of army structures and defence armaments.</p> <p>b) The remote structural health monitoring can be done using impedance based miniaturized AD5399 chip.</p> <p>c) The automated low cost adaptation for EMI technique can be used extensively for monitoring defense structures.</p>  |



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| 91 | Development of LTCC Hotplate for Sensor Application   | CEERI, Pilani | 2 Jul 10  | 2 Years | 29.60 | <ul style="list-style-type: none"> <li>• Identification of geometries for hotplate design for optimum power consumption &amp; simulation of temperature distribution.</li> <li>• LTCC layout design of the hotplate and mask fabrication.</li> <li>• Evolution of the process steps for fabrication of hotplate using LTCC technology</li> </ul> <p>Broadly including – slitting, blanking, via-punching, bulk/laser micromachining, via-filling, screen-printing, lamination, co-firing, post-printing, firing, dicing etc.</p> <ul style="list-style-type: none"> <li>• Fabrication of hotplate based on the above LTCC process and optimization.</li> <li>• Fabrication of temperature stable bonds for LTCC hotplates.</li> <li>• Testing and Characterization of the LTCC hotplates.</li> <li>• Design and development of Gas Analysis in LTCC for toxic and other gases.</li> <li>• Detailed characterization of LTCC hotplates, at various temperatures in continuous mode for large number of cycles and related studies.</li> <li>• Exploration on the initiation of primary explosives and pyrotechniques.</li> <li>• Characterization and design optimization studies.</li> </ul> |
| 92 | Optimization and standardization of the Human Powered Electric Generator  | CEERI, Pilani | 8 Jul 10  | 2 Years | 7.70  | <ul style="list-style-type: none"> <li>• Complete optimization, standardization and design procedure done.</li> <li>• Standardization and design method simulated (SABER and MAGNETO software) and verified by hardware.</li> </ul>  |
| 93 | Experimental and Numerical Investigations of the Ballistic Resistance of Ductile Targets Subjected to Oblique Impact by Sharp Nosed Projectiles | IIT, Roorkee  | 28-Feb-11 | 3 Years | 23.02 | <p>a) A detailed material characterization was carried out for ArmoX 500T steel, 7075-T651 aluminium and API projectile materials.</p> <p>b) The target as well as projectile material was calibrated for obtaining the parameters of Johnson-Cook elasto-visco plastic material model.</p> <p>c) The ArmoX 500T steel plates of 6,8 and 10 mm thickness were impacted by 7.62 API projectile and 5,10,15 and 20-mm thickness by 12.7 API projectiles. The aluminium plates of thickness 20,32,40 and 50 mm were impacted by 7, 12.7 API projectiles. The angle of incidence was varied until the occurrence of projectile ricochet.</p>   |

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| 94 | Development of Eco-friendly Methods,                                       | North Maharashtra U          | 31-Oct-11 | 2 Years  | 17.91 | (a) 200gm CDN Submitted<br>(b) CDN provides energetic composites which is useful in gun propellants and explosives.<br>(c) CDN is a novel nitrating agent and its utility has been explored.<br>(d) Nitration of some activated and deactivated aromatic compounds using CDN has been carried out.   |
| 95 | Friction Stir Welding of AA7075 Thick Plates for Heavy Vehicle Application | Tagore Engg College, Chennai | 20-Jun-12 | 2 Years  | 14.03 | (a) Up to 25 mm thick plates of AA 7075 – T651 were successfully welded and tested.<br>(b) Light microscopy was employed to extensively study the macro and microstructural features of various welds.<br>(c) Defect free single pass friction stir welds were made on 10,16 and 25 mm plates.<br>(d) Correlations between process parameters, microstructure and mechanical properties established. |
| 96 | Specialized Antenna for Communication Through Metallic Enclosures          | IIT, Kharagpur               | 14 Mar 14 | 9 months | 25.33 | Antenna has been simulated, fabricated and measured its performance found to meet the specification  |

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