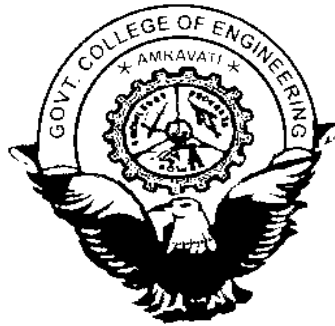


**Proposal for**

**ESTABLISHMENT OF RESEARCH &  
DEVELOPMENT CENTER**



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**GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI**

Post VMV, Kathora Naka, Amravati 444 604

**2009-10**

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## EXECUTIVE SUMMARY

Government College of Engineering, Amravati, established in the year 1964, is one of the six engineering colleges in the state run by Govt. of Maharashtra. The institute started with undergraduate programs in basic disciplines i.e. Civil, Electrical and Mechanical Engg. Later on two more UG programs in Electronics and Telecommunication and Computer Science and Engineering were introduced in 1986. Subsequently Instrumentation Engg. and Information Technology are introduced in 1996 and 2001 respectively. The institute is autonomous and affiliated to Sant Gadge Baba Amravati University, Amravati. Five full time M.Tech Programs in Electrical Power System (1996), Structural Engg. (2004), Thermal Engg. (2004), Environmental Engg. (2006) and Electronics System and Communication (2009) are offered with an intake of 18 each. In addition to this the institute is also offering five part time M. Tech programs with total intake of 65. The present annual intake for UG is 390 and for PG 155. Out of these programs six UG and one PG program are accredited by National Board of Accreditation, AICTE, New Delhi till the year 2011. The total strength of students during 2009-10 is 1954. The Institute has been a part of TEQIP and has successfully implemented the program in its true spirit. The major achievements in TEQIP include Campus Networking, Library Building with latest facilities, a strong power back up, Academic Excellence through autonomy, Language Laboratory, Excellent students performance in examinations and placement, and creating awareness of community and society amongst faculty and students.

Technology changes very rapidly and therefore, the facilities in every technical Institute become obsolete vary fast. Therefore, it is always necessary to support technical institutes regularly by providing assistance to upgrade infrastructure so as to excel in research and innovations.

### **Need of the program**

The institution is greatly benefited by TEQIP and is well set for undergraduate education. However, the area of PG education and research needs to be taken care of. The institute is still striving hard to be amongst reputed institutions in the country. Being oldest and reputed institution in the region the society expects to generate researchers and competent technical manpower from the institutes. Hence expanding and strengthening the PG education and also improvement in research is indispensable.

The National Knowledge Commission Report speaks much about the quality of teaching learning process in UG and PG education in engineering. The quality and quantity of PG education and also research leading to Ph. D. have been identified as major issues responsible for quality of engineering education. Therefore, both the areas are required to be addressed on urgent basis. Research, both routine and creative and its dissemination through publications and conferences are central to the intellectual character of institution of higher learning. Therefore, every institute having vision of becoming excellent needs to have research and development center in its premises. It will not only provide the platform to young and vibrant faculty to carry out their research but also will provide innovative and creative ambience in the institute. Such ambience shall ultimately encourage and motivate UG students and shall help institute to become excellent.

National Knowledge Commission has also highlighted on a serious issue of faculty shortage. A faculty holding UG degree need to be encouraged to acquire masters degree as early as possible. Existence of multi disciplinary and innovative masters programme in the

institute shall not only attract and retain good faculty but also good students who currently go abroad for doing their masters shall also be encouraged to peruse their education in the country.

It is therefore proposed to establish separate research and development (R & D) center, housing research oriented set ups, equipments and measuring equipments related to all disciplines of engineering. A central R & D facility shall help to come up multi disciplinary research. It is also proposed to start one multi disciplinary Masters Programme (M. Tech.) in Nanotechnology and one multi disciplinary programme (B. Tech.) in Bio-Medical engineering. The concept shall further be extended to starting of UG course in Bio Technology.

### **Proposed R & D Center**

A separate building for research and development center is proposed to be constructed. The different research areas, pertaining to various disciplines identified for multidisciplinary research are as follows.

1. Nanotechnology
2. Bio Medical Engineering
3. Micro Machining
4. Rapid Prototyping
5. Advance Power Computation
6. Advance Electrical Machines
7. Non Destructive Testing and Retrofitting
8. Advance Water and Wastewater Engineering
9. Neuro Computing
10. Embedded System Design
11. Digital Signal Processing

In view of commitment of our institute to provide competent technical man power to cater the needs industries and R & D institutions, observations and recommendation of National Knowledge Commission as well as list of emergent areas identified by association of industries have been referred while selecting these areas. The institute intends to undertake fundamental and applied research on enabling technologies which are likely to be central to future developments in engineering. Our strategy is to maintain a balanced portfolio of developments on a broad range of research topics, and to promote pullthrough of R&D to commercial exploitation and applications encompassing different emergent areas. The detailed justification for selection of above areas is given in section 2 of this report.

The financial requirement for establishment of R & D center of Govt. College of Engineering, Amravati is as follows.

<b>Component</b>	<b>No of sub activities</b>	<b>Requirement in Rs. Laks</b>
Infrastructure (Building)	Construction of Building for Research and development center housing all research facilities (1500 sq.m)	180.00
Equipment	<b>Research and Development center</b>	

	Nanotechnology Center	820.0
	Mechanical Engg.	
	• Micromachining	30.0
	• Rapid Prototyping	15.0
	Electrical Engg.	
	• Advanced Power System Computation	20.5
	• Advanced Electrical Machines	32.0
	Civil Engg.	
	• Advance Water and Wastewater Engineering	30.0
	• Non Destructive Testing and Retrofitting	59.5
	Computer Technology	
	• Neuro Computing	24.0
	Electronics and Telecommunication	
	• Embedded System Design	12.00
	• Digital Signal Processing	53.00
Grand Total		1276.0

The establishment of research and development center with the facility proposed in the report is expected to create an unique opportunity to all stake holders of the institute. The facility so created shall be useful to carry out laboratory / dissertation work of M.Tech students and shall work as an extension to laboratory work of UG students. The faculty will be encouraged to carry out multidisciplinary research and hence shall result in increase in publications / patents. Majority of the facilities are proposed from the point of view of generating internal revenue through training and consultancy.

This shall also have some additional benefits to students:

- Students set to take certain ad-on courses
- Students undertake summer projects in areas of practical interest
- Faculties are in touch with the latest in the field and have access to latest research equipments.
- Equipments can also be used for calibration purpose and hence produce internal revenue

## SECTION 1

### INSTITUTE PROFILE

1.1 Name of the Institution: **Govt. College of Engineering, Amravati**

1.2 Status of the Institute: An Autonomous Institute of Govt. of Maharashtra

1.3 Engineering Programs offered in 2009-10

S. No	Title of Program	Duration (Years)	Year of Starting	Sanctioned Annual Intake	Total Student Strength	Accreditation Status
<b>Undergraduate Courses</b>						
1	Civil Engg.	4	1964	60	297	2008-11
2	Mechanical Engg.	4	1964	60	284	2008-11
3	Electrical Engg	4	1964	60	285	2008-11
4	Electronics & Telecommunication	4	1986	60	283	2008-11
5	Computer Science & Engg.	4	1986	60	283	2008-11
6	Instrumentation	4	1996	30	142	2008-11
7	Information Technology	4	2001	60	288	-
<b>Postgraduate Courses Full Time</b>						
8	Electrical Power Systems	2	1996	13	14	2008-11
9	Thermal Engineering	2	2004	13	15	-
10	Structural Engineering	2	2004	13	13	-
11	Environmental Engg.	2	2006	13	07	-
12	Electronics System and Communication	2	2009	13	13	-
<b>Postgraduate Courses Part Time</b>						
13	Electrical Power Systems	3	1996	13	05	-
14	Thermal Engineering	3	1986	13	13	-
15	Environmental Engg.	3	1986	13	07	-
16	Geotechnical Engg.	3	1986	13	03	-
17	Advanced Electronics	3	1986	13	----	-

#### 1.3 Background of the Institute :

The institute is one of the premier institutions in Vidarbha region, and oldest engineering college affiliated to Amravati University. The college has set up a great tradition and has produced eminent engineers who are competent and committed to the highest professional standards in the field of engineering and technology.

The institute has more than 40 years of standing and has produced as many as 8420 UG's, 195 PG's and 17 Ph.D's. The institute was a part of Canada India Industry Institute Linkage Project (CIILP) implemented by Govt. of India during 2001-04. The Institute has

also participated in Technical Education Quality Improvement Programme (TEQIP) of Govt. of India. The institution has young and dedicated faculty, who are enthusiastic to face the challenges of the technical education in the 21<sup>st</sup> century through its active and wholehearted participation in development of institution.

The institute is located on the out skirts of Amravati city with a spacious campus of 105 Acres and has reasonably good infrastructure (buildings, hostels, play ground, auditorium etc.) facilities. The Institute has separate laboratories and classrooms in all the departments with sufficient space. The building area for Academic & Administration is 22887 sq.m. and for hostel accommodation 9093sq.m. The Institute has excellent library facilities which include Internet, Library Automation, Eklavya Channel, Book Bank (Set of 5-7 Books for 71% of Students), Digital Library (20 Nodes). Books and periodicals in electronic form are also available in the library. A collection of 69175 books (including book bank) is available for the users. The library has 355 on-line journals for IEEE, Science Direct, ASCE, ASME etc. The library is a member of INDEST consortium, through which online national and international journals are available to the users.

The institute has started implementation of autonomy since academic session 2005-06 and prepared entire latest curricula for both, UG and PG courses. The performance of the students is increasing remarkably in examinations, competitive examination like GATE, CAT, GRE etc and also in campus placement. The placement of 41%, 68%, 75%, 94% during last four years indicates tremendous improvement. The major companies that visit the campus include Cognizant, Wipro, IBM, Geometric Software Solutions, Infosys, TCS, Tech-Mahindra, Persistent Systems, Syntel, Satyam, L & T, Siemens, Reliance Energy, Tata Power, ESSAR, Mahindra & Mahindra group, Kirloskar Group of Companies, Hindustan Construction, Shapurji & Pallonji etc.

#### **Vision of Institute**

***To provide competent technical manpower to cater to the needs of the industry,  
R & D institutions for the overall upliftment of society  
and  
To become center of excellence in the country imparting quality technical education  
meeting Global Standards.***

## SECTION 2

### JUSTIFICATION FOR R & D CENTER

#### 2.1 Preamble

The institute is currently offering seven B. Tech., five each full time and part time M. Tech. programs with an annual intake of 390, 90 and 65 respectively. Out of these programs eligible six UG and one PG programme are accredited by National Board of Accreditation, AICTE, New Delhi till the year 2011. The Institute has sufficient laboratory and library facilities. The Institute has maintained its academic reputation since its establishment.

The faculty members are encouraged to participate in Quality Improvement Programmes for acquiring higher qualification. The faculty is also highly motivated to participate in consultancy and testing services, thereby generating much needed revenue for the institute. The institution has been a part of Technical Education Quality Improvement Program (TEQIP) of Govt. of India under World Bank Assistance. The major benefits from the project include:

- Campus wide Networking for 1000 nodes
- Construction of building for Central Library in-housing the latest facilities
- Research publications during last four years (2005-06, 2006-07, 2007-08, 2008-09) has been 77, 85, 90 and 95 respectively in journals / conferences.
- MoU's signed with NIIT (for computer instructional programmes), Cognizant Technology Solutions, Wipro and L & T InfoTech (for sponsoring special programs, student workshop, Guest lectures, subject experts, FDP, Awards to student / faculty), IIT Bombay (for high quality education through C-DEEP, Remote centre for Interactive Teaching & Virtual Classroom).
- Major laboratories developed: Language laboratory, Heat transfer, CAD/CAM, Geotechnical Engineering, Computer network, Soft Computing, EDC, Power electronics, Control system, Switch Gear & Protection, Process Instrumentation and Electronics Instrumentation.

The industry associations in the country have reported that hardly 30% engineering graduates are employable. This is clearly an indicator of low quality of technical education being imparted. The major contributor for this cause is poor quality of practical training on outdated equipments and no incorporation of research component in teaching learning process. Therefore it is necessary to update and upgrade the laboratories by procuring equipments capable of demonstrating latest technology and hands on experience. Few of the laboratory facilities should also have recent instrumentation and control so as to create enthusiasm in the students to promote their innovative skills.

#### 2.2 Justification

Undergraduate laboratories are perhaps the weakest chain in engineering education. The students feel it boring and not intellectually challenging. Laboratory teaching is a second rated job for the teachers. The laboratory training provide technical competence in usage of machine, experimental research skill, creativity and design skill, decision making skill, team

work etc. The major problem with the laboratory equipment is that they fail to attract students and staff. Moreover, the laboratories of departments are equipped with the equipments which are quite old. Due to rapid change in the technology, these equipments become outdated. To meet the challenges of the rapidly changing technologies it is extremely essential to give thrust upon the modernization of existing facilities in the laboratories.

The grants available to the institute from MODROB / RPS / TAPTECH / DST schemes of the central government are insufficient to modernize the laboratory upto research level.

In view of the above, major shortcomings in the existing infrastructure are as follows;

1. Equipments are not compatible to advancement and can not be used for research.
2. Poor instrumentation and control and hence lack of motivation to faculty for research.
3. Poor facilities for in-house research and hence fewer referred publications and patents.
4. Standard of existing laboratory is just enough to cater UG needs.
5. Absence of facility for multi disciplinary research and high technology for industrial research

In order to overcome these shortcomings and to create professional and research ambience, it is proposed to establish research and development center. The emerging areas in different discipline of engineering and capable of providing platform for interdisciplinary research have been identified. List of such areas along with justification for selection of these equipments is as given below;

### **1. Nanotechnology Centre**

#### **Area of research:**

- i. Nano surface Engineering
- ii. Super hard nano composite coatings
- iii. Nano structures
- iv. Nano crystalline thin films
- v. Synthesis of nano collides / rods / wires
- vi. Nano photo chemistry and photo physics

#### **Work expected:**

- i. To train and equip M.Tech (Nanotechnology) students in the subjects like, Nano scale materials, Physics of Nano Materials, Nano Materials and Technology, Structural analysis of Nano material, Transport Phenomena, Metallographic techniques etc.
- ii. To perform some practicals of UG course (Nanotechnology as an elective subject)
- iii. To provide inter disciplinary research platform to faculty members of this and nearby institutions.
- iv. To provide consultancy in design of nanomaterials for various applications.

## **2. Micro-Machining**

### **Area of research:**

- i. Electrical discharge machining is primarily used for hard metals or those that would be very difficult to machine with traditional techniques.
- ii. The material removal mechanism in EDM is not yet well understood and that further investigation is necessary to clarify it.
- iii. Research can be carried in the area of surface finish, new dielectric fluids, new wire materials, metal removal rate and machining of new materials.

### **Work expected:**

- i. To carry out research for enhancing applications of EDM in difficult to machine materials.
- ii. Utilizing facility for carrying out machining of local jobs
- iii. To identify different electrolytes for cost effective machining

## **3. Rapid Prototyping**

### **Area of research:**

- i. State-of-the-art in additive technologies and hybrid fabrication in the areas including medical, aerospace, fluid power, metal fabrication, nano-tech, bio-tech, and bio-molecular education.
- ii. For designing and creating patterns of complicated shapes.
- iii. Research in the area of surface finish, new model materials and metal deposition rate.

### **Work expected:**

- i. To conduct Ph. D. research in the areas specified mentioned above.
- ii. Design of patterns of complicated shapes in plastic industries
- iii. To be used for performing actual experiments for UG students.

## **4. Advanced Power System Computation**

### **Area of research:**

- i. Power system restructuring and deregulation

### **Work expected:**

- i. Design of computerized fault finding and diagnosis schemes for power systems.
- ii. Carrying out the Research and Consultancy Projects on
- iii. Power Systems
- iv. Providing the Solutions to Power System Problems to
- v. various power sectors operating in new environment
- vi. Performing the experiments in innovative ways

## **5. Advanced Electrical Machines**

### **Area of research:**

- i. Energy efficient motors
- ii. Fault detection and diagnosis of motors
- iii. Advanced testing of motors

### **Work expected:**

- i. Design of Energy efficient motors
- ii. Research on improvement of performance of existing machines in industries.

## **6. Advanced Water and Wastewater Engineering**

### **Area of Research:**

- i. Quality monitoring / assessment of pollution up to micro-levels
- ii. Determination of heavy metals, sample of high dissolve solids

### **Work expected:**

- i. Used for experiments and project / dissertation work at UG and PG
- ii. Testing and consultancy in water, wastewater, and industrial effluents.
- iii. Quality monitoring / assessment of pollution up to micro-levels, consultancy regarding testing of water and wastewater to detect micro-nutrients / micro-pollutants especially Mercury, Chromium, Lead, Zinc etc.

## **7. Non destructive testing of R. C. C. Structures**

### **Area of research:**

- i. Retrofitting of buildings
- ii. Determination of buildings risk and vulnerability levels

### **Work expected:**

- i. Preparation of designs for retrofitting of buildings,
- ii. To develop the reliable methods of diagnosis of damages so as to prevent further damage arising out of the same causes, in RCC-structures to prolong their useful life
- iii. To take decision of repairing / retrofitting / rehabilitation of structures
- iv. To know quantitative and precise measurements of characteristic properties of materials, extent of degradation/distress in structures.
- v. To suggest guidelines, ideas for deciding strategies for repair, maintenance, or demolition of structures.

## **8. Neuro Computing**

### **Area of research:**

- i. Neuro Computing tools like Artificial Intelligence, Artificial Neural Network & Fuzzy logic
- ii. Digital Image Processing

**Work expected:**

- i. Supervising the work for PhD and Masters degree theses,
- ii. Conducting a value addition Certificate Course on Neuro Computing and Digital Image Processing,
- iii. conducting collaborating projects, evaluating project proposals for funding them by DST through the center and monitoring the progress,

**9. Embedded System Design****Area of research:**

- i. Design and development of various modules in control consumer electronics , industrial electronics .
- ii. Development of efficient algorithms
- iii. Integrated Development Environment

**Work expected:**

- i. An embedded system is designed to perform specific function and is a combination of hardware & software, and has become an essential part of any product or equipment in all fields including telecommunications, medical, industrial, consumer products etc.
- ii. The design and development of various modules leading to the formation of a new product in control sector. As well,
- iii. Develop variety of subsystems for consumer electronics.
- iv. Development of efficient algorithms in open source software packages as language compilers, Integrated Development Environment (IDE).

**10. Digital Signal Processing****Area of research:**

- i. Time-varying signal processing using DSP processors
- ii. Advanced filter designing algorithms and techniques
- iii. Digital encoding-decoding

**Work expected:**

- To transmit and receive signals to enhance desired signal components, and extract useful information carried by the signal.
- The design, development and testing of efficient algorithms to perform various operations of signal processing including digital filtering, encoding/decoding.

### SECTION 3

### LIST OF EQUIPMENTS

The emergent areas for research in different disciplines have been identified in Section 2. On the basis of present status of research in these areas and on the basis of expertise available in the institute the equipments have been identified. The list of these equipments research wise is given below. The specifications of these equipments are decided so as to make these suitable for researchers.

S. No.	Name of Equipment with Brief Specification	Make & Model of Equipment	Quantity	Unit Cost (Rs.in lacs)	Total Cost (Rs.in lacs)
<b>NANOTECHNOLOGY CENTRE</b>					
1	Transmission electron microscope with EDS i. Magnitude- 50x to 8,00,000x. ii. Operating voltage-20kV to 120kV. iii. Resolution- Line to line 1.4 A and point to point 3.0A. iv. Goni. Stage – Tilt -45° to +45° v. Temp. range- 77K to 1250K vi. Image record- 35mm camera, plate camera and viewing screen.	Philips EM 400	1	300.0	300.0
2	X-ray diffractometer i. Targets- Cu,Fe,Mo ii. Working voltage- 10 to 100 kV iii. Tube current- 4.0 to 80 mA. iv. Goni.scanning range- 0° to 150° v. Accessories- High temp., complete analysis software and ICDD library.	Bruker AXS D8 Advance	1	100.0	100.0
3	Scanning Electron Microscope i. Resolution- 4nm in HV & 6nm in VP ii. Voltage upto 30 kV iii. Magnification: 10X to 300,000 X iv. Stage: X,Y,Z, theta, phi and Eucentric Goniometer v. Detection Mode: SE&BSD vi. Image recording: Printer & Camera	LEO 435 VP	1	125.0	125.0
4.	Electron probe micro analyzer i. Detectable elements: B <sup>5</sup> to U <sup>92</sup> ii. Voltage 0.5-50 kV iii. Probe current: 10 <sup>-12</sup> to 10 <sup>-5</sup> A iv. Beam Pix: 0 to 300µm v. Sem resolution 6 nm vi. No. of spectrometer-3 vii. Crystal used TAP, PET, LIF	PAR 155	1	150.0	150.0
5.	Universal type industrial microscope with	Nikon	1	8.0	8.0

	digital camera. Attachment with image analysis software	Eclipse LV100			
6.	Spectro photometer. i. Installation category II ii. Pollution degree 2 iii. Safety class I	Varian make Cary 5000 model.	1	32.0	32.0
7.	Differential scanning calorimetry i. Temperature range: Ambient to 700 °C: - 170 °C to 500 °C ii. With cooling accessories: (Liquid Nitrogen Accessory)	Setaram Instrumentat ion, KEP technologies dsc131evo model	1	12.0	12.0
8.	Ball mill i. Material feed size: <8 mm ii. Final fineness: 5 µm iii. Batch size / feed quantity: max. 2 x 20ml	Retsch PM 400/2	1	16.0	16.0
9.	Zetasizer i. Size range 0.6nm - 6 microns* ii. Minimum sample volume 12µL iii. Concentration range 0.1mg/mL Lysozyme to 40%w/v* iv. Measurement angle 173° Zeta potential measurement v. Minimum sample volume 0.75mL vi. Maximum sample conductivity 200mS/cm	Malvern Instruments Nano ZS 900	1	20.0	20.0
10.	UV visible NIR- Horospectro photometer with nano lvs attachment	Horiba Jobinyvon iHR 320	1	40.0	40.0
11.	Spin coater i. Rotaton speed: 1 - 10.000 RPM ii. Acceleraton: 1 - 50.000 RPM/sec iii. Max substrate size: diameter 8" or square 6"x6" iv. HP temperature range: up tp 300 °C 0.1 °C	SPIN 150	1	9.0	9.0
12.	LCR meter i. All AC functions. ii. Frequency range: 6505P 20Hz to 5MHz iii. Mode of operation: Meter mode/Setup Data	Wayne kerr 6500p	1	8.0	8.0
<b>Total</b>					<b>820</b>
<b>MICRO-MACHINING</b>					
1.	CNC Wire Cut EDM Table Size: 440 X 650 mm Max. Work piece Height: 200mm Max. Cutting Speed: 160mm <sup>2</sup> /min	Make: Electronica Model: Sprintcut	01	30.00	30.00

	Best Surface Finish: 0.8 $\mu$ Ra Taper: $\pm 30^\circ/50$ mm e pulse technology				
<b>Total</b>					30.00
<b>RAPID PROTYPING</b>					
1.	Rapid Prototyping Machine Build Size: 203 x 203 x 305 mm Layer thickness: 0.178 mm or 0.254 mm of precisely deposited material Workstation compatibility: Windows® XP Network connectivity: Ethernet TCP/IP 10/100 Size and weight: 68 x914x1041 mm, 136 kg Power requirements: 220-240 VAC 50 Hz,	Make: Stratasys Inc. Model: Dimension Elite	01	15.00	15.00
<b>Total</b>					15.00
<b>ADVANCED POWER SYSTEM COMPUTATION</b>					
1	<u>Transmission Line Simulator</u>  <ul style="list-style-type: none"> <li>• It can connect to other parts of Modular Power System for even advanced experiments</li> <li>• Allows realistic studies of short, medium and long-distance transmission lines under variable load and power factor conditions, as well as with inserted faults</li> <li>• Fault application switch and earth fault resistors allow studies of earth fault currents and the operation of relays of varying sensitivity</li> <li>• Enables ‘Pi’ or ‘Tee’ methods of loss profiling</li> <li>• Separate single and three-phase line simulations</li> <li>• Built-in industrial-standard digital protection relay gives wide range of functions – module includes extra socket for additional relay to give more experiments</li> <li>• Detailed mimic diagram and clear labeling help students’ understanding</li> <li>• Includes work surface and cable racks for convenient and efficient use</li> <li>• Includes supplies, circuit protection, internal load banks, instruments and controls</li> </ul> <p><u>Three-phase lines:</u> Five sections, each at 0.15 p.u. value: 75 km of 132 kV line on a 100 MVA base One section at 0.25 p.u. value: 125 km of</p>	Indigenous	01	4.0	4.0

	<p>132 kV line on a 100 MVA base</p> <p><u>Three-phase load banks:</u> Resistive, inductive and capacitive</p> <p><u>Other controls and instrumentation:</u></p> <ul style="list-style-type: none"> <li>• Phase angle meter for single-phase and three-phase</li> <li>• Fault switch</li> <li>• Single-phase and three-phase selectable capacitor banks for pi and T networks</li> <li>• Switchable neutral from transformer secondary</li> </ul>				
2	<p><u>Thyristor Controller Series Capacitor test system</u></p> <p>This demo models a Thyristor Controlled Series Capacitor placed on a 500kV, long transmission line, to improve power transfer. The TCSC consists of a fixed capacitor and a parallel Thyristor Controlled Reactor (TCR) in each phase. When the TCSC is bypassed, the power transfer is around 110MW. The effects of operating the TCSC in capacitive, inductive or manual alpha modes can be analyzed. The effects of varying the reference impedance on the power transfer can also be viewed. In the capacitive mode the range for impedance can be varied from 120 to 136 Ohm. This range corresponds to approximately 490 to 830MW power transfer range (100%-110% compensation). When compared with the power transfer possible of 110 MW with an uncompensated line, the TCSC enables significant improvement in power transfer level. In the inductive and alpha modes the range for impedance can be varied from 19 to 60 Ohm to see that the power transfer ranges varies from 100 to 85 MW.</p> <p>System Configuration: Application Package AD-GRID-20 CPU Type Dual Intel® Core™ 2 Quad Processors with a clock speed of 2.3 GHz and 2 GB RAM Number of CPUs 1 Time Step 50us</p>	Indigenous	01	2.0	2.0
3	<p><u>Thyristor-based SVC</u></p> <p>The real-time simulation of an SVC (static VAR compensator) was made on 2</p>	Indigenous	01	2.0	2.0

	<p>independent RT?LAB simulators. The plant part, which includes the main power system source, transformer, a thyristor controlled reactor, and 3–thyristor, switched capacitor banks, was made on a dual-Xeon-based RT?LAB simulator. The controller part, which includes a PI compensator, synchronization unit, and thyristor firing pulse units, was made with a Pentium-M-based RT?LAB simulator. Both simulators were equipped with the necessary I/O to interface to each other: The controller had analog input to read the power system voltages and digital output to fire the thyristor. The plant simulator had complimentary I/O (analog output and digital inputs).</p> <p>System Configuration Application Package AD-GRID-03</p>				
4	<u>eZ DSP Starter Kit TMS320F2812 With Code Composer Studio</u>	TMS320F2812	01	1.5	1.5
5	<u>FPGA Starterkit Cyclon-III FPGA EP3C16</u>	FPGA EP3C16	01	3.0	3.0
6	<p><u>Textronics DSO</u> 350 MHz, 5 GS/s, Non-isolated</p> <ul style="list-style-type: none"> <li>• Channel : 4</li> <li>• Type : TDS 5034B with <u>AC/DC Current Probe</u></li> </ul> <p>Input: 0-70 A Rms 100 A Peak, AC or DC frequency: DC to 100 kHz Output 10 mV/A, 100 mV/A</p>	TDS 5034B	01	3.0	3.0
7	<u>Wavestar software for Textronics DSO</u>	Indigenous	01	2.0	2.0
8	<p><u>High Voltage Differential Probe</u> Input : +/-1000 V Rms, 1300 Peak Output &lt;= 2.6 V into 1 MOhms Over Range: 1/50, 1/500</p>	Indigenous	02	1.5	3.0
<b>Total</b>					20.5
<b>ADVANCED ELECTRICAL MACHINES</b>					
1	<p>Computer compatible laboratory test bench for electrical machines-</p> <p>Test bench capable of performing various steady state and dynamic experiments on dc(compound), induction (squirrel cage) and synchronous machine(wound field/PM line</p>	Indigenous	01	32.00	32.00

	start/PM inverter driven).				
				<b>Total</b>	32.00
<b>ADVANCED WATER AND WASTEWATER ENGINEERING</b>					
1	<p><b>Atomic Absorption Spectrophotometer</b></p> <p>PC based high performance; optical double beam Atomic Absorption Spectrophotometer with WINDOWS XP based software, True double beam optics, High resolution grating, New high-through put Dynamic Beam Manager for high sensitivity measurements–Direct Pb quantization of 0.1 ppb in flame analysis, Complete measuring wavelength range from 900 nm to 185 nm with automatic setting, 4-step bandwidth selection, Auto switch able dual detector system, multi-lamp motorized turret controlled through software, Flame absorption and flame micro-sampling measurement modes, D<sub>2</sub> background correction,</p> <p>High efficiency nebulizer, Platinum-Iridium orifice and Ceramic impact bead, Titanium burner with motorized up-down movement, Fully computerized gas flow control system, All safety functions, Automatic ignition and extinction of flame, hollow cathode lamps, Window based software for strengthened QA / QC functions, High temperature burner head, Computer with monitor, Laser jet Printer</p>	Indigenous	01	16.00	16.00
2	<p><b>Gas Chromatograph</b></p> <p>Gas chromatograph Microprocessor based, Modular GC system with Dual Packed Column Injection Port with Dual Flow Line Advance Flow Controller (AFC) and High Sensitivity Dual FID Detector system, Consisting of Large column oven, 20 step column, programming with rate setting, Fast column oven cooling with microprocessor rear vent control; Dual Packed Column Injection port, Advanced Flow Controller (AFC) for digital setting and control of carrier gas flow, 7-step flow programming capability with programming rate, Correction function to maintain constant column flow rate, High</p>	Indigenous	01	14.00	14.00

	Sensitivity Differential Dual FID Detector system, Minimum detection limit for FID of 3 pgC/s for Dodecane with dynamic range of 10 <sup>7</sup> , Inert Quartz nozzle for FID, Automatic ignition and re-ignition of FID flame, Large interactive Graphical User Interface (GUI) LCD display, Intelligent self-diagnostics functions, Capability for installing simultaneously 3 injections ports and 4 detectors on single system, Split / Splitless Injection Port with built-in AFC for digital setting and control of carrier gas pressure, Built-in 7 step pressure / flow programming, Digital split ratio setting, Correction function, Compatibility to complete range of capillary columns, FID Jet, Gas Purification Panel, Window based Winchrome Single channel software, Computer with monitor, LaserJet Printer				
<b>Total</b>					30.00
<b>NON DESTRUCTIVE TESTING OF R. C. C. STRUCTURES</b>					
1	<p><b>Permeability Tester</b></p> <p>Each Basic Unit includes:</p> <ul style="list-style-type: none"> <li>• 1 Nos. display unit with nonvolatile memory for up to 200 measured objects – Display on 128x128 graphic LCD – Interface RS 232</li> </ul> <p>Print out of measured objects and transfer to PC with MS Hyperterminal – Battery operation with six 1.5 V, LR batteries, Temperature range –10° to +60° C</p> <ul style="list-style-type: none"> <li>• 1 Nos. transfer cable 9/9-poles, 1.5 m</li> <li>• 1 Nos. printer cable 9/9+25-poles, 1.5/0.3 m for printer with serial interface</li> <li>• 1 Nos. carrying strap</li> <li>• 1 Nos. carrying case 325 x 295 x 105 mm</li> <li>• 1 Nos. control unit comprising membrane pressure regulator pressure sensor – two-chamber vacuum cell</li> </ul> <p>vacuum connection: small flange 16 KF • 1 Nos. carrying case 520 x 370 x 125</p> <p><u>VACUUM PUMP</u></p> <p>Basic Unit TORRENT is operated with a commercial vacuum pump. Technical data according to DIN 28400: - suction capacity 1.5 m<sup>3</sup>/h – final total pressure 10 mbar</p> <p>suction-side connection: small flange</p>	Model : TORRENT	01	10.00	10.00

	10KF/16KF, high water vapour toleration				
2	<p>DYNA PULL OFF TESTER</p> <p>Display Unit Type</p> <p>DYNA Tensile force: 6Kn</p> <p>Resolution Accuracy: 0.01N/mm<sup>2</sup> &lt;2%</p> <p>Permissible stroke: 4mm</p> <p>DYNAMETER Display device with non volatile memory for 1000 measured values</p> <p>DISPLAY: 128x128 graphic LCD</p> <p>INTERFACE: RS232</p> <p>INTEGRATED SOFTWARE: transmission of all measured values to printer and PC</p> <p>TEMPERATURE RANGE: -10° to +60°C</p> <p>BATTERY: 6 LR6, 1.5V (60 hours operation)</p> <p>Delivered with carrying strap, operating instructions and carrying case 320x295x105mm, total weight 1.8kg</p> <p>Each Basic Unit includes:</p> <ul style="list-style-type: none"> <li>• 1 Nos. Pull-Off Tester Z6E with pressure sensor</li> <li>• 1 Nos. 50mm test disc</li> <li>• 1 Nos. tensile bolt</li> <li>• 1 Nos. carrying case</li> <li>• 1 Nos. electronic display unit</li> </ul> <p>DYNAMETER</p> <p>Tensile Force : 6 KN</p>	Proceq/ MODEL NAME: DYNA	01	6.0	6.00
03	ERUDITE MK 4(Resonant Frequency Tester) along with accessories as per BS1881:4 to test i)Concrete ii)Ceramics and refractories iii) Stone and rock iv)Carbon and graphite	ERUDITE	01	7.00	7.00
04	German's Gas permeation Test along with accessories	AE&C	01	4.0	4.00
05	PUNDIT 7-Portable ultrasonic non destructive indicative tester Complete with reference bar, two transducers (54kHz), ultrasound couplant, two 3 metre cables and manual on CD. 85/250Vac 50/60Hz. Carrying Bag is included.	CNS-FARNLL/P UNDIT 7 Cat. No. PC1012°	01	3.0	3.00
06	Combined Impulse Response & Impact Echo test system along with the complete processing software & Hardware consisting of instrumented hammer with calibration certificate, rubber tip,	Make :Germann, Denmark Model : s'MASH-	01	28.00	28.00

	transducer for 360 degree testing, PCMCIA card, two handheld displacement transducers capable of measuring response at frequencies up to 80KHz, 300 mm transducer support, star support with 5, 8 & 12 impactors, extra short handle, displacement transducer tip protection caps(4 nos.), operating manuals, notes and test cases complete with laptop computer installed amplifier box.	4000 Impulse response & DOC-2000 Impact Echo test system( Confirming to ACI228.2R & ASTM C 1383			
07	Silver Schmidt Hammer  Impact energy 2.207 Nm Hammer mass 115 g Spring constant 0.79 N/mm Spring extension 75 mm Housing dimensions 55 x 55 x 250 mm (340 mm to tip of plunger) Dimensions (visible part of plunger) 105 x ø15 mm / radius of spherical tip 25 mm Weight 600 g Electrical data Display 17 x 71 pixels; graphic / alphanumeric Power consumption ~13mA measuring, ~4 mA setup and review, ~0.02 mA idle Accumulator duty >1000 impacts (before recharging) Charger connection USB type B (5V, 100 mA)	Proceq/MODEL NAME: TYPE BN	01	1.5	1.50
<b>Total</b>					59.50
<b>NEURO COMPUTING</b>					
1	<b>Image Processing development toolkit</b> for 32-bit Windows® XP / Vista®. Includes DVDs with MIL, ONL, ActiveMIL, Intellicam, Inspector, Matrox display drivers and on-line documentation. Also includes a perpetual license USB hardware key	Matrox, Matrox imaging library	05 Users	2.5	12.50
02	<b>Frame Grabber* :</b> Dual-Base or single-Medium up to 66 MHz Camera Link® PCI-X® frame grabber with 64 MB DDR SDRAM and cable adapter board. Requires Imaging Library ,Host Controller and IMAGEPRO- A Digital Image Processing Software <b>Camera :Compact 2 Mega pixel 2/3''</b>	Matrox, Matrox Solios eV-CL Frame Graber	01	8.00	8.00

	Color CCD camera link camera, 25fps, with power supply, cable & Camera Stand <b>Lens Kit:</b> Includes five Lens of focal length 8/16/25/35/50mm with rear converter 1.5x/2x/2.5x & extension tubes				
03	<b>Host Controller :</b> Intel® Xeon® processor (Quad- Core/2.33GHz/12M L2 Cache),Intel® 5000X ,RAM 2 GB DDRII,160 GB HDD, Gigabit Ethernet onboard, Graphics nVIDIA 512 MB Graphics Accelerator, Windows Xp Professional,19” TFT Mointor, DVD Writer, Expansion Slots 2 PCIe & 3 PCI-X (Dedicated for Matrox Solios & IMAGEPRO- A Digital Image Processing Software installed on it ) & PCI slots with one year warranty	Matrox, Host Controller	01	3.50	3.50
<b>Total</b>					24.00
<b>EMBEDDED SYSTEM DESIGN</b>					
1	NI Single board RIO: Floating point processor 400MHz,Reconfigurable FPGAs, Networking peripherals	National Instruments	04	0.5	2.00
2	ARM Development suite: Evaluation board with 8-32 bit microcontrollers, ARM simulations, Integrated Development Environment & RTOS with application modules	National Instruments/ SPJ Systems	05	0.40	2.00
3	Software Defined Radio:SDR Board,codecomposer studio,single DSP RTOS for ‘C6x,DSP,FPGA,DAQmodule	Agilant Technologie s	01	8.00	8.00
<b>Total</b>					12.00
<b>DIGITAL SIGNAL PROCESSING</b>					
1	Spectrum Analyzer: 9KHz-30GHz,RBW 10Hz-10MHz,TFT display,RS232 & GPIB interface	Agilant Technologie s	01	18.00	18.00
2	Multi-Purpose lab Station: Mixed signal scope, arbitrary, ,waveform generator, programmable DMM/Power supply, VEE Pro test measurement & automation software	Agilant Technologie s	01	15.00	15.00
3	RF Signal Generator 9 KHz to 20 GHz, Rsolution 0.1 Hz, Amplitude, frequency and phase modulation	Agilant Technologie s	01	20.00	20.00
<b>Total</b>					53.00
<b>GRAND TOTAL = 1096 Lakhs</b>					

## SECTION 4

### POSSIBLE OUTCOME

The facility created in R & D center shall help institute to establish excellence in the technical education in general and in the relevant areas in particular. Besides projecting image of the institute, the possible outcomes from each of the facilities are listed below.

S. No.	Name of Equipment	Expected outcome
<b>NANOTECHNOLOGY CENTRE</b>		
1.	All equipments	<ul style="list-style-type: none"> <li>• Performance of laboratory work/dissertation work of M.Tech (Nanotechnology) students</li> <li>• Performance of laboratory work of UG students offering Nanotechnology as an elective subject</li> <li>• Research publications/patents of PG students/faculty members.</li> <li>• Consultancy to the related industries in the near by area.</li> </ul>
<b>RAPID PROTYPING</b>		
1	Rapid Prototyping Machine	<ul style="list-style-type: none"> <li>• Research publications in the area of Design and Manufacturing</li> <li>• PhD / M. Tech students can do their research work</li> <li>• Consultancy will be provided to the local industry</li> <li>• To manufacture production-quality parts in relatively small numbers for analysis</li> </ul>
<b>MICRO-MACHINING</b>		
1	CNC Wire Cut EDM	<ul style="list-style-type: none"> <li>• Research publications in the area of Micro machining</li> <li>• PhD / M. Tech students can do their research work</li> <li>• Manufacturing of parts for the local industry</li> <li>• Revenue generation through training and consultancy</li> </ul>
<b>ADVANCED POWER SYSTEM COMPUTATION</b>		
1	All equipments	<ul style="list-style-type: none"> <li>• Innovative experiments to be introduced in UG/PG curricula</li> <li>• Use for testing and consultancy</li> <li>• PG and Doctoral research work</li> <li>• State of art experiments in power system computation</li> </ul>
<b>ADVANCED ELECTRICAL MACHINES</b>		
1	Computer compatible laboratory test bench for electrical machines	<ul style="list-style-type: none"> <li>• Innovative experiments to be introduced in UG/PG curricula</li> <li>• Use for testing and consultancy</li> <li>• PG and Doctoral research work</li> <li>• State of art experiments in power system computation</li> </ul>

<b>ADVANCED WATER AND WASTEWATER ENGINEERING</b>		
1.	Atomic Absorption Spectrophotometer (PC based) including software, and compressor	Analysis of very low concentrations of various metals such as Cr, Hg, Pb etc. in water / wastewater / soil / Pesticides / Cement etc. up to 0.001 mg/L and lower becomes possible. Detection of pollution of water and quality of mineral water, soft drinks that may contain very low concentrations of various metals. UG / PG experiments and project / dissertation works.
2.	Gas Chromatograph (Microprocessor based) including Chromatography software)	Analysis of very low concentrations of pesticides / organic compounds in water / wastewater / soil etc. up to 0.001 mg/L and lower becomes possible. It can be used to detect the effect of extensive use of pesticides / insecticides for agriculture and thereby pollution of nearby streams / lakes / ground water due to various organic compounds.
<b>NON DESTRUCTIVE TESTING OF R. C. C. STRUCTURES</b>		
1	Permeability Tester	Testing and consultancy on Non-destructive measurement of the permeability of concrete structures.
2	DYNA PULL OFF TESTER	<ul style="list-style-type: none"> <li>• Determining the adhesive strength on concrete structures and the tension strength of concrete:</li> <li>• Measuring the adhesive strength of applied coatings such as plastic coatings, concrete coats, mortars and plasters, bituminous coats and paint finishes and coatings on metal.</li> <li>• Checking of completed renovation/repair work on metal.</li> <li>• Testing and consultancy</li> </ul>
3	ERUDITE MK 4(Resonant Frequency Tester)	To measure longitudinal resonant frequency
4	Resistivity Meter RESI (for measurement of corrosion)	Measuring corrosion status of reinforcement in RCC structures
5	PUNDIT 7-Portable ultrasonic non destructive indicative tester	Testing and consultancy on concrete strength, concrete uniformity cracks / cavities/dynamic modulus of concrete
6	Combined Impulse Response & Impact Echo test system	<ul style="list-style-type: none"> <li>• To precisely locate the presence &amp; depth of cracks, voids, honeycombing, thickness of two dimensional flat structures</li> <li>• For on site screening for flaws &amp; identifying suspect areas of a structures, for evaluating voids beneath concrete slabs in floors, highways, spillways, delamination &amp; honey combing in bridge decks, slabs, walls &amp; large structures</li> </ul>
7	Silver Schmidt Hammer	Measuring compressive strength of concrete/ surface hardness of concrete
<b>NEURO COMPUTING</b>		
1	Image Processing development toolkit	<ul style="list-style-type: none"> <li>• Solve applications by leveraging a toolkit</li> <li>• Tackle applications for analyzing, locating,</li> </ul>

		<p>measuring, reading, and verifying</p> <ul style="list-style-type: none"> <li>• Harness the full power of hardware through optimizations exploiting SIMD, multi-core CPU<sup>1</sup>, multi-CPU<sup>1</sup>, GPU<sup>2</sup> and FPGA technologies</li> <li>• Support platforms ranging from smart cameras to HPC clusters via a single consistent and intuitive API</li> <li>• Obtain live images from the interface of choice through support for analog, Camera Link®, GigE Vision®<sup>2</sup>, IEEE 1394 IIDC<sup>2</sup>, RS-422/LVDS and SDI transmission formats</li> <li>• Make the best use of available programming know-how with support for C, C++, C# and Visual Basic® languages</li> <li>• Further increase productivity and reduce development costs</li> </ul>
2	Frame Grabber* :	<ul style="list-style-type: none"> <li>• Perform deterministic image acquisition</li> <li>• Eliminate missed frames</li> <li>• Optimize multi-camera applications</li> <li>• Reduce development and validation costs</li> <li>• Implement image capture with ease and confidence</li> </ul>
3	Host Controller	<ul style="list-style-type: none"> <li>• Over 5 GB per second of memory bandwidth</li> <li>• 512 MB of DDR SDRAM memory</li> <li>• integrated quad-input analog frame grabber acquires up to 640 MB per second</li> <li>• up to 1 GB per second of I/O bandwidth to host PC</li> </ul>
<b>EMBEDDED SYSTEM DESIGN &amp; DIGITAL SIGNAL PROCESSING</b>		
1	NI Single board RIO: Floating point processor 400MHz,Reconfigurable FPGAs, Networking peripherals	Development and testing of new modules in control/consumer electronics, which can be converted to a commercial endeavor
2	ARM Development suite: Evaluation board with 8-32 bit microcontrollers, ARM simulations, Integrated Development Environment & RTOS with application modules	Development and testing of new modules in control/consumer electronics, which can be converted to a commercial endeavor
3	Software Defined Radio: SDR Board, code composer studio, single DSP RTOS for 'C6x,DSP,FPGA,DAQmodule	Design and testing of new modules, for wireless communication sector, which can be converted to a commercial endeavor
4	Spectrum Analyzer: 9KHz- 30GHz,RBW 10Hz- 10MHz,TFT display,RS232 &	Testing and analysis of complex signal so as to find the properties of signals to undertake proper modifications in development work, if needed

	GPIB interface	
5	Multi-Purpose lab Station: Mixed signal scope, arbitrary, waveform generator, programmable DMM/Power supply, VEE Pro test measurement & automation software	All the generation, test and measurement of complex signals in a single setup can be obtained.

Besides above overall expected outcome of the project shall be as under;

- Starting of M. Tech. programme in Nanotechnology.
- Offering B. Tech. programme in Bio- Medical Engineering
- Increase in research output: increase in publications in referred journals
- Filing applications for patents
- In-house research facility shall increase the number of Ph. D. registration
- Employability of UG students shall increase
- A quality M. Tech. education with research competent embedded in teaching-learning process
- A Ph. D. research programme can be started in the areas described above.