

PVMS OF RADIOLOGY

DRAFT

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<p>1.</p>	<p>3 Tesla Wide Bore MRI System for Health Deptt.</p> <p>Latest Generation, latest Technology High Resolution 3.0 Tesla Wide Bore, Superconducting Magnetic Resonance Imaging (MRI) system with ZERO Boil off Cryogen Technology. High Homogeneity, latest generation gradients and digital radio frequency (RF) system to be capable of all 2D & 3D routine including Neuro imaging , Body, Spine, Orthopedics, pediatrics, cardiac and peripheral vascular imaging.</p> <p>MRI system should comprise of the following specifications.</p> <p>PERFORMANCE</p> <ul style="list-style-type: none"> • Simultaneous scanning, image acquisition, image reconstruction, processing and filming etc. • Capability to execute multi sequence automated scanning & post processing through simplified, • Preferably single mouse-click operations. • The system should offer Imaging packages for Neurosciences, Orthopedics, Cardiology, Angiography, Body, Breast, Oncology & Pediatric etc with following minimal capabilities at console. • Feet-first positioning for almost all examinations possible reduces anxiety and claustrophobia. • Window width/level controls, zoom, pan, rotate, mirror. • Image annotation, Image arithmetic, Image measurement • Regions of Interest (ROI) statistics (area, volume, mean and standard deviation) from user defined square, rectangular, circular, elliptical or irregular shapes. <p>Time Intensity analysis of dynamics/phases. Volume calculation from contours drawn in adjacent slices. Simultaneous visualization of up to four independent series for comparison. Cine movie display of 20 slices or more dynamics/phases Reduction of noise over images with edge enhancement. Real-time MIP, MPR and 3D surface rendering. Film generation of image series with capability to export to DICOM/Windows PC formats.</p> <p>MAGNET</p> <ul style="list-style-type: none"> • Magnet Type: Super-Conductor • Field strength: 3 Tesla • Helium Boil off: Zero boil off with 10 years helium <p>warranty</p> <ul style="list-style-type: none"> • Shielding method: Active • Shimming Method; Active / passive • Bore Diameter: 70cm or More • Magnet Length: 170 cm or less • Magnet Field Stability: 0.1 Ppm/Hr • FOV: 5-50 cm <ul style="list-style-type: none"> • Other features: Operating panel on both sides of gantry with patient positioning display, laser light localization, In-Bore lighting & ventilation • Magnet Homogeneity: 1.2 ppm or less in 40cm DSV • <p>RF SYSTEM</p>
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<ul style="list-style-type: none"> • Transmitter Type: Digital/Optic Fiber based RF system • Transmitter Power: 25 KW or more • RF receiver Channels: 32 standard simultaneous independent receiving channels /direct digitization (48 channel as optional) • For 32 channels coil connectivity using optic fiber transmission. (48 channel as optional) • Gradient: 44 mT/m or more • Slew Rate: 200 mT/m/s or more 	
EXAMINATION COILS	
<ul style="list-style-type: none"> • Whole Body Coil • Head/neck Head Imaging (parallel imaging compatible) • Spine (parallel imaging compatible) • Neuro-Vascular / Coil (head & Neck) • Torso Coil Torso coil (parallel imaging compatible) • General purpose / Flex Coil • Dedicated coils • Ankle • Shoulder • Wrist • Knee coil • Breast Coil • Multiple Coil Connection 	<ul style="list-style-type: none"> Gantry Integrated Whole Body imaging ≥20 Elements or more, Head Coil For ≥32 Element or more spine coil ≥ 28 Element Array Neuro Vascular Coil For Aortic Arch And Carotid Imaging/coil Combination of head/neck/spine Combination. (Parallel imaging compatible) ≥ 30 Element or More /with coil combination 8 elements or more 16 elements or more (parallel imaging compatible) 16 elements or more (parallel imaging compatible) 16 elements or more (parallel imaging compatible) 15 elements or more. (parallel imaging compatible) 8 elements or more Able to perform whole body imaging using surface coils simultaneously
ACQUISITION PARAMETER	
<ul style="list-style-type: none"> • Slice thickness 2D • Slice thickness 3D • Parallel Imaging 	<ul style="list-style-type: none"> 0.2 mm or better 0.1 mm or better The system should offer parallel imaging capability
(Sense/ASSET/iPAT/Speder/RAPID)	
<ul style="list-style-type: none"> • Acquisition matrix 	1024 x 1024
PATINET COUCH AND COMFORT	
<ul style="list-style-type: none"> • Type • Weight Bearing Capacity • Table Length • Min. Height • Gating 	<ul style="list-style-type: none"> detachable/fixed motorized patient table with height lowering capability (feet first) 225 Kg or more 2.0 meter 0.7 meter or less VCG/ ECG Cardiac gating system,

	<p>Peripheral pulse gating system, (or compatible)</p> <ul style="list-style-type: none"> • Motion Correction • Intercom <p>Patient & Operator</p> <ul style="list-style-type: none"> • Safety/Emergency Run Down, Safety Switches For Emergency Ramp Down <p>Overhead couch built in camera along with LCD display (CONSOLE / HOST/ RECON)</p> <ul style="list-style-type: none"> • Standard Console <p>base</p> <ul style="list-style-type: none"> • Hard Disk Capacity • Clock speed better; 32 GB Ram or more • DVD/CD R/W • Connectivity/Networking • Display Monitor (Flicker free & High Resolution) • Word size • Reconstruction Speed • FFT/Sec (256x256 Matrix) at full field of view • All Imaging sequences and MR applications as listed below (MRI DEDICATED/Multimodality WORKSTATION) <p>Original Workstation by same Manufacturer as MRI system to be offered. Qty – 3Nos, with licensed software having three concurrent user licenses with necessary hardware and should be independent of MRI console)</p> <ul style="list-style-type: none"> • Standard Console • Hard Disk Capacity • DVD/CD R/W • Connectivity/Networking • Display Monitor • CPU & RAM • OS/Linux 	<p>Respiratory gating system</p> <p>Motion correction for all anatomy</p> <p>Integrated Two Way Communication Between</p> <p>Standard Key board And Mouse, friendly interface</p> <p>1TB or more / per manufacturers highest provision Minimum storage capacity of maximum uncompressed image At 256 x 256 matrix</p> <p>2.4 GHz quad core processor or</p> <p>DVD /CD Writer must be included</p> <p>DICOM 3.0 Query/Retrieve, Modality Work-list, Storage & Print to be Included (with licenses)</p> <p>19 inches or more LCD/TFT monitor</p> <p>64 bit parallel array processing</p> <p>Minimum 12000 Images or</p> <p>Standard Key board And Mouse, user friendly interface base</p> <p>(1 TB or as per manufacturers highest provision /Minimum storage capacity of 250,000 uncompressed images At 256 x 256 matrix</p> <p>DVD /CD Writer must be included</p> <p>DICOM 3.0 Query/Retrieve, Modality Worklist,</p> <p>19 inches or more LCD/TFT monitor (Flicker free & High Resolution)</p> <p>Intel Quad Core processor 2.4 GHz/AMD Opteron & 12 GB RAM or as per Recommendation (windows XP 64 bits</p>
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- **Post Processing** Post Processing for Basic & advanced MR applications to be included with auto shifting of data from the console to the workstation.

STANDARD IMAGING SEQUENCES, BASIC & ADVANCED APPLICATIONS FOR CONSOLE/WORKSTATION

Accessories

1. Spin Echo (single and multi-echo)
2. Fast Spin Echo
3. Gradient Echo
4. Inversion Recovery, IR-STIR, FLAIR, dual IR for fat fluid and tissue suppression.
5. Fast Inversion Recovery, Fast FLAIR
6. Echo Planner Imaging (Single & Multi Shot)
7. 2D & 3D FFE and 2D & 3D balanced FFE
8. 2D & 3D TFE and 2D & 3D balanced TFE
9. 2D & 3D TOF (including TURBO, gating)
10. 3D Motion correction
11. Phase Contrast 2D & 3D
12. Fat Suppression (at least 4/5 different techniques)
13. Contrast Enhanced MRA with automatic table movement
14. 3D isotropic imaging
15. Diffusion Imaging with ADC maps for application in brain and body in real time.
16. MRCP 2D and 3D
17. Perfusion imaging with online calculation of hemodynamic maps like mean transit time, time to peak, time of arrival etc.
18. Brain Perfusion Arterial Spin Labeling (2D and 3D)
19. Bolus tracking for real time synchronization of contrast bolus arrival.
20. Fetal anomaly survey/similar software
21. Single and multi shot EPI-free selection capability of single or multi shot EPI
22. Dynamic Imaging (brain, liver, breast)
23. Brain Volume Imaging
24. Diffusion Tensor Imaging + Tractography
25. Spectroscopy – Single
26. Spectroscopy – Multi-Voxel (Brain, Breast and Prostate)
27. Functional MRI/ (BOLD Imaging) with online processing.
28. Flow Analysis software with display of peak velocities
29. Motion Correction for all anatomy and in functional imaging.
30. Fluoro Triggered MRA
31. MPR-Multi Planner Reconstruction
32. Magnetization transfer imaging
33. Advanced volumetric imaging with T2, T2 Flair and Proton density weighted contrasts / Similar Solution.
34. Cartilage Mapping / Similar for non-invasive imaging method for early detection of osteoarthritis
35. Time Resolved Imaging in high resolution of multi-phase 3D volumes of any anatomy for fast accurate visualization of the vasculature
36. 3D non-contrast enhanced MRA application for brain, carotid and peripheral arterial imaging.
37. 3D Arterial Spin Labeling – Non Contrast whole brain perfusion

38. High resolution T2 weighting for clear depiction of inner ear structures and facial nerve.
39. MR Elastography/relaxography or similar sequence for brain, liver, breast and prostate.
40. Susceptibility weighted imaging or similar software.
41. Fusion software
42. Cardiac imaging package. (optional)
43. 4D/advanced Cardiac imaging package(optional)
44. MRI angiogram (cardiac), flow measurements, offline analysis, coronary imaging, (optional).
45. Advanced Orthopedic software(optional)
46. Advance vascular package including 3D peripheral arterial imaging (optional)
47. Advance Liver imaging (optional)

The firms should quote all other optional and advanced available applications / packages for neuro, vascular / angiography, oncology, brain, abdomen, orthopedics etc separately as optional (which will not form the basis of acceptance / rejection)

B- Functional imaging software and hardware. (optional as per institution's requirement)

ACCESSORIES

1. 2 MRI Compatible wheel Chairs
2. 1 MRI Compatible patient care monitor / display on MRI Screen
3. 2 MRI Compatible Trolley
4. 2 MRI Compatible IV Pole
5. Metal detectors door and hand held detector.
6. SYSTEM COMPATIBLE 200 KVA PRIME POWER (USA, EUROPE AND JAPAN ORIGIN) Diesel Power generator for MRI including ATS, Sound Proof Canopy, Foundation Pads, Earthing and cabling.
7. Standard set of phantoms for calibration of MRI.
8. 160 KVA Online sine Wave Double Conversion UPS for whole MRI suite, with a minimum backup time of 20 minutes on full load, (MGE, Emerson, Liebert, Chloride, Riello, APC and GE)
9. Programmable, MRI Compatible Dual Head power injector with flow / volume and temperature control. Mounted on mobile base with 500 disposable syringes of 150ml capacity and connecting tubes (Medrad, Angiomat/Madtron/Tyco).
10. DICOM 3 Ready Dry Laser Camera / Imager, multi-size up to 14" x 17" for different size films (Carestream, Agfa, Fuji, Konica) for black & white printing on film, including 1,000 films.
11. Film Viewer (x 04) for images up to 14" x 17" with variable light control and shutter, with 4 1 format ; LED type.(Qty-02)
12. Imported Water Chillers as per requirement of the system with standby arrangement.
13. RF cage as per manufacturer's recommendation and according to site requirement (USA, Europe or Japan).
14. MRI compatible adult/paediatrics anesthesia machine with compatible ventilator, mobile type. Two Gas Model machine (oxygen and nitrous). Oxygen Monitor, Isoflurance vaporizer. Compatible with AMBU bag. Close circuit system, Circle absorber, flow meter with sets compatible cylinders.
15. Music system for patient during MRI.

16. Renovation and up gradation of waiting area and reporting room.
17. Two film storage cabinets (14 x 17 film holding).
18. MR compatible stretcher
19. Provision of storage aluminum racks, aluminum doors with elbow action controls, paneling, lead lining, flooring, paints etc. Oxygen and suction system connection with the existing hospital pipeline. Provision of furniture (benches, LCD TV, water dispenser etc) of MRI waiting area. Complete electricity works from power station to MRI room including earthing, power racks, breakers, DB etc.

TRAININGS

1. 02 x Technician local training for 02 week. The comprehensive training covering operations, calibrations and basic services protocols.
2. 02 x visits of foreign Application Specialist (02 week duration for each visit).
3. 02 x Radiologist Doctors foreign Trainings in a Teaching University Hospital affiliated with the manufacturer for 2 weeks.

INTERNATIONAL SAFETY AND QUALITY ASSURANCE FOR MRI

1. MDD Compliance (CE Marked)
2. FDA 510K Approval
3. Country of Manufacturing: USA / Europe / Japan

WARRANTY

1. 05-Years Manufacturer's comprehensive warranty of the unit along with other third party items will be provided including service and spare parts of the system, UPS and Generator.

MAJOR TERMS AND CONDITIONS

1. The Manufacturer should have documentary evidence to the effect that they are the original Manufacturer of the quoted product with indication of manufacturing site and its location.
2. Certificate of the manufacturer that they will execute the Contract single handedly or jointly with their local agent.
3. Certificate from the manufacturer that the after sales services / backup services shall be provided jointly with the local agent and in case of change of local agent, they will provide the after sales services themselves or through newly appointed agent for five years from the date of commissioning.
4. Lay out plan / drawing with fringe field calculation along with the bid.
5. A Certificate from the manufacturer that the installation will be conducted in conformity with the system requirements by following professional approach.
6. Commitment of the manufacturer for providing Comprehensive 05-Years Warranty and post warranty @ 06.5% of Contracted value for next 05 years.
7. Satisfactory Past performance of the firm for a similar quoted item.
8. Sufficient Technical and Engineering capabilities of the firm (attach a list of technical and engineering staff, special testing equipment/calibration/ repair tools for MRI system)
9. Submission of valid legally enforceable authorization letter of manufacturer assuring full guarantee and warranty obligations as per enclosed manufacturer authorized form with the bid document.
10. The products offered from foreign countries of USA, Europe and Japan shall be eligible to participate and must bear FDA 510k and CE standard, respectively and those products should be marketed world widely. (The product manufactured and marketed for certain region shall be knocked down).

11. Infrastructure for execution of after sales services mentioned by the bidder shall be evaluated for its suitability as per provisions given in specifications and other requirements detailed in the technical specifications of the bidding documents.

12. The firms shall also declare the make, model, country of origin of all accessories to be provided with the equipment.

13. The Procuring Agency has the right to inspect the premises of bidder to inspect the setups ensuring proper after sales services.

MANUFACTURER WARRANTY/ TERMS & CONDITIONS:

1. The manufacturer will undertake to maintain the equipment during the period of warranty which shall be for five years from the date of full functional commissioning with all specified parameters and shall cover labor and parts for all equipment supplied / stated in the contract including non-proprietary parts, accessories, transducer, batteries etc. The manufacturer will also undertake to provide the availability of spare parts for next five years and confirmation of after sales services through its sole agent or directly.

2. The manufacturer will provide Performance Guarantee for the period of warranty, in the form of Bank Guarantee equivalent to 5% of the value of the Contract.

3. The manufacturer will sign the Contract Agreement along with its Local agent for ensuring prompt after sales services.

4. The Warranty will start from the date after proper installation, as per contracted specifications and handing over of system.

5. The maintenance will be the responsibility of the manufacturer and the agent. An annual optimal uptime of 95 % is considered as acceptable level of performance.

6. Software and hardware up gradation of the computing system should be carried out as available during warranty period as recommended by the manufacturer.

7. Manufacturer/ Supplier shall be responsible for rectifying with all possible speed at their own expense any defect or fault in the system which may develop at any time during installation, commissioning period.

8. The Manufacturer will guarantee the availability of spare parts and accessories for the system for ten years as per service agreement.

9. The firm will bound to execute the installation/ maintenance according to the installation/ service protocol and will replace the components/ kits recommended by the manufacturers for installation and Periodic Preventive maintenance.

10. The scheduled preventive maintenance shall be in accordance with Service Protocol recommended/ advised by the manufacturer.

11. The manufacturer will connect the system to their Remote Diagnosis and Service Centre via modem for pick-up early faults at no cost to the hospital.

	<p>12. The manufacturer/ supplier will be responsible for preventive maintenance of equipment as per manufacturers' Service Manuals and shall keep a check for electrical / magnetic / temperature and humidity conditions. Such a check should be made monthly and record should be maintained in the log book of the hospital.</p> <p>13. The manufacturer will certify that the system will be used for continuous scanning/ examination purposes for at least two working shifts (at least from 8.00am to 10.00pm) without deterioration of performance and other parameters</p> <p>PRE-REQUISITE:</p> <ol style="list-style-type: none"> 1. The firms must quote their leading brands from the above mentioned origins with the proven past performance nationally and internationally. 2. The firm must possess its related back up support services including trained engineers, workshop facilities, spare parts availability and repair/calibration tools etc. 3. The firm will submit the details regarding managerial, engineering, history of past projects, testing tools, key engineer's qualifications and their relevant trainings related to MRI Scanner etc. which will be verified by the technical team to access its qualification for determining the eligibility. Only the qualified eligible firms will be evaluated further as per evaluation criteria. 4. Similar 2 unit of 3T MRI must be installed and enjoy good reputation in Pakistan or Asian market for minimum two years. The quoted model should be developed/ produced by the manufacturer not earlier than five years for high tech equipment (which will be counted from the date of its certification). 5. MRI system the manufacturer will provide the Warranty; local agent's Warranty will not be acceptable. The manufacturer will further certify that in case of change of its agent, it will provide after sales services itself or through their newly appointed agent. 6. The firms shall quote make and models, country of origin for each main equipment, accessories and allied equipment also.
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2.	<p>MRI SPECIFICATIONS, 1.5 TESLA FOR HEALTH DEPTT.</p> <p>60 CM BORE</p> <p>MAGNET</p> <ul style="list-style-type: none"> • Magnet Type: Super-Conductor • Field strength: 1.5 Tesla • Helium Boil off: Zero boil off with 10 years helium warranty • Shielding method: Active /passive • Shimming Method; Active / passive • Bore Diameter: 60 cm or More • Magnet Length: 170 cm or less • Magnet Field Stability: 0.1 Ppm/Hr • FOV: 5-50 cm
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	<ul style="list-style-type: none"> Other features: Operating panel on both sides of gantry with patient positioning display, laser light localization, In-Bore lighting & ventilation Magnet Homogeneity: 1.2 ppm or less in 40cm DSV or 2 ppm or less in 50cm DSV
	RF SYSTEM
	<ul style="list-style-type: none"> Transmitter Type: Digital/Optic Fiber based RF system Transmitter Power: 10 KW or more RF receive Channels: 16 standard simultaneous independent receiving channels /direct digitization for 16 channels coil connectivity using optic fiber transmission or more. Gradient: 33 mT/m or more Slew Rate: 120 mT/m/s or more
	EXAMINATION COILS
	<ul style="list-style-type: none"> Whole Body Gantry Integrated Whole Body imaging Coil Head/neck 11 Elements or more, Array Head Coil For Head Imaging (parallel imaging compatible) Spine 12 Element or more spine coil (parallel imaging compatible) Neuro-Vascular / Coil 16 Element Array Neuro Vascular Coil For Aortic Arch And Carotid Imaging / Coil Combination of head/neck/spine Torso Coil 16 Element or More /with coil combination Torso coil (parallel imaging compatible) General purpose / Flex Coil 8 elements or more (4 channels-Siemens) Dedicated coils Ankle 16 elements or more (parallel imaging compatible) / Flex Coil Shoulder 6 elements or more (parallel imaging compatible) Wrist 6 elements or more (parallel imaging compatible) Knee coil 8 elements or more. (parallel imaging compatible) Breast Coil 8 elements or more Multiple Coil Connection At least 3 coils (Head, body & Spine) must be connectable simultaneously
	ACQUISITION PARAMETER
	<ul style="list-style-type: none"> Slice thickness 2D 0.2 mm or better Slice thickness 3D 0.1 mm or better Parallel Imaging The system should offer parallel imaging capability
	(Sense/ASSET/iPAT/Speder/RAPID)
	<ul style="list-style-type: none"> Acquisition matrix 1024 x 1024
	PATINET COUCH AND COMFORT
	<ul style="list-style-type: none"> Type Motorized patient table with height lowering

	<p>capability</p> <ul style="list-style-type: none"> • Weight Bearing Capacity 200 Kg or more • Table Length 2.0 meter • Min.Height 0.7 meter or less • Gating ECG Cardiac gating system, Peripheral pulse gating system, Respiratory gating System or VCG or compatible. • Motion Correction Motion correction for all anatomy • Intercom Integrated Two Way Communication Between Patient & Operator • Safety/Emergency Run Down, Safety Switches For Emergency Ramp Down • Feet first scanning <p>Overhead/ couch built in camera along with LCD display (CONSOLE / HOST/ RECON)</p> <ul style="list-style-type: none"> • Standard Console Standard Key board And Mouse, Automated Scanning capability and user friendly interface base • Hard Disk Capacity 1TB or more /or manufacturers maximum specified with minimum storage capacity of 250,000 uncompressed image at 256 x 256 matrix • DVD/CD R/W DVD /CD Writer must be included • Connectivity/Networking DICOM 3.0 Query/Retrieve, Modality Worklist, Storage & Print to be included • Display Monitor 19 inches or more LCD/TFT monitor (Flicker free & High Resolution) • Reconstruction Speed Minimum 5000 Images or FFT/Sec (256x256 Matrix) at full field of view • Image Reconstruction Intel Quad Core/AMD Opteron & 8GB RAM or more CPU & RAM • All Imaging sequences and MR applications as listed below <p>(MRI DEDICATED WORKSTATION)</p> <p>Original Workstation by same Manufacturer as MRI system to be offered. Qty – 3Nos or thin client solution offering same functionality with licensed software having three concurrent user licenses with necessary hardware)</p> <ul style="list-style-type: none"> • Standard Console Standard Key board And Mouse, user friendly interface base • Hard Disk Capacity 400GB or more /Minimum storage capacity of 400,000 uncompressed image At 256 x 256 matrix • DVD/CD R/W DVD /CD Writer must be included • Connectivity/Networking DICOM 3.0 Query/Retrieve, Modality Worklist, Storage & Print to be included
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- Display Monitor 19 inches or more LCD/TFT monitor (Flicker free & High Resolution)
- CPU & RAM Intel Quad Core/AMD Opteron & 12 GB RAM or as per manufacturer
- Recommendation or Linux OS.
- Post Processing applications to be included Post Processing for Basic & advanced MR

Accessories

1. Spin Echo (single and multi-echo)
2. Fast Spin Echo
3. Gradient Echo
4. Inversion Recovery, IR-STIR, FLAIR, dual IR for fat fluid and tissue suppression.
5. Fast Inversion Recovery, Fast FLAIR
6. Echo Planner Imaging (Single & Multi Shot)
7. 2D & 3D FFE and 2D & 3D balanced FFE
8. 2D & 3D TFE and 2D & 3D balanced TFE
9. 2D & 3D TOF (including TURBO, gating)
10. 3D Motion correction
11. Phase Contrast 2D & 3D
12. Fat Suppression (at least 4/5 different techniques)
13. Contrast Enhanced MRA with automatic table movement
14. 3D isotropic imaging
15. Diffusion Imaging with ADC maps for application in brain and body in real time.
16. MRCP 2D and 3D
17. Perfusion imaging with online calculation of hemodynamic maps like mean transit time, time to peak, time of arrival etc.
18. Brain Perfusion Arterial Spin Labeling (2D and 3D)
19. Bolus tracking for real time synchronization of contrast bolus arrival.
20. Fetal anomaly survey/similar software
21. Single and multi shot EPI-free selection capability of single or multi shot EPI
22. Dynamic Imaging (brain, liver, breast)
23. Brain Volume Imaging
24. Diffusion Tensor Imaging + Tractography
25. Spectroscopy – Single
26. Spectroscopy – Multi-Voxel (Brain, Breast and Prostate)
27. Functional MRI/ (BOLD Imaging) with online processing. (optional)
28. Flow Analysis software with display of peak velocities
29. Motion Correction for all anatomy and in functional imaging.
30. Fluoro Triggered MRA
31. MPR-Multi Planner Reconstruction
32. Magnetization transfer imaging
33. Advanced volumetric imaging with T2, T2 Flair and Proton density weighted contrasts / Similar Solution.
34. Cartilage Mapping / Similar for non-invasive imaging method for early detection of osteoarthritis
35. Time Resolved Imaging in high resolution of multi-phase 3D volumes of any anatomy for fast accurate visualization of the vasculature
36. 3D non-contrast enhanced MRA application for brain, carotid and peripheral arterial imaging.
37. 3D Arterial Spin Labeling – Non Contrast whole brain perfusion

38. High resolution T2 weighting for clear depiction of inner ear structures and facial nerve.
39. MR Elastography / Relaxometry or similar sequence for body (optional).
40. Susceptibility weighted imaging or similar software.
41. Fusion software
42. Cardiac imaging package. (optional)
43. 4D / Advanced Cardiac imaging package(optional)
44. MRI angiogram, flow measurements, offline analysis, coronary imaging, (optional).
45. Advanced Orthopedic software(optional)
46. Advance vascular package including 3D peripheral arterial imaging (optional)
47. Advance Liver imaging (optional)

The firms should quote all optional as well as advanced available applications / packages for neuro, vascular / angiography, oncology, brain etc separately as optional (which will not form the basis of acceptance / rejection)

OPTIONAL:

- 70cm bore system (End user to justify)
- 32-Channel system (End user to justify)

B- Functional imaging software and hardware. (optional as per institution's requirement)

ACCESSORIES

1. 2 MRI Compatible wheel Chairs
2. 1 MRI Compatible patient care monitor / display on MRI Screen
3. 2 MRI Compatible Trolley
4. 2 MRI Compatible IV Pole
5. Metal detectors door and hand held detector.
6. COMPATIBLE PRIME POWER (USA, EUROPE AND JAPAN ORIGIN) Diesel Power generator with power compatible for MRI suite including ATS, Sound Proof Canopy, Foundation Pads, Earthing and cabling.
7. Standard set of phantoms for calibration of MRI.
8. 160 KVA Online sine Wave Double Conversion UPS for whole MRI suite or compatible with the system, with a minimum backup time of 20 minutes on full load, (MGE, Emerson, Liebert, Chloride, Riello, APC and GE)
9. Programmable, MRI Compatible Dual Head power injector with flow / volume and temperature control. Mounted on mobile base with 500 disposable syringes of 150ml capacity and connecting tubes (Medrad, Angiomat/Madtron/Tyco).
10. DICOM 3 Ready Dry Laser Camera / Imager, multi-size up to 14" x 17" for different size films (Carestream, Agfa, Fuji, Konica) for black & white printing on film, including 1,000 films.
11. Film Viewer (x 04) for images up to 14" x 17" with variable light control and shutter, with 4 1 format ; LED type.(Qty-02)
12. Imported Water Chillers as per requirement of the system with standby arrangement.
13. RF cage as per manufacturer's recommendation and according to site requirement (USA, Europe or Japan).
14. MRI compatible adult/paediatrics anesthesia machine with compatible ventilator, mobile type. Two Gas Model machine (oxygen and nitrous). Oxygen Monitor, Isoflurane vaporizer. Compatible with AMBU bag. Close circuit

system, Circle absorber, flow meter with sets compatible cylinders.

15. Music system for patient during MRI.
16. Renovation and up gradation of waiting area and reporting room.
17. Two film storage cabinets (14 x 17 film holding).
18. MR compatible stretcher
19. Provision of storage aluminum racks, aluminum doors with elbow action controls, paneling, lead lining, flooring, paints etc. Oxygen and suction system connection with the existing hospital pipeline. Provision of furniture (benches, LCD TV, water dispenser etc) of MRI waiting area. Complete electricity works from power station to MRI room including earthing, power racks, breakers, DB etc.

TRAININGS

1. 02 x Technician local training for 02 week. The comprehensive training covering operations, calibrations and basic services protocols.
2. 02 x Application specialist visit for 01 week
3. 02 X Radiologist Doctors foreign Trainings in a Teaching University Hospital affiliated with the manufacturer for one week.

INTERNATIONAL SAFETY AND QUALITY ASSURANCE FOR MRI

1. MDD Compliance (CE Marked)
2. FDA 510K Approval
3. Country of Manufacturing: USA / Europe / Japan

WARRANTY

1. 05-Years Manufacturer's comprehensive warranty of the unit along with other third party items will be provided including service and spare parts of the system.

MAJOR TERMS AND CONDITIONS

1. The Manufacturer should have documentary evidence to the effect that they are the original Manufacturer of the quoted product with indication of manufacturing site and its location.
2. Certificate of the manufacturer that they will execute the Contract single handedly or jointly with their local agent.
3. Certificate from the manufacturer that the after sales services / backup services shall be provided jointly with the local agent and in case of change of local agent, they will provide the after sales services themselves or through newly appointed agent for five years from the date of commissioning.
4. Lay out plan / drawing with fringe field calculation along with the bid.
5. A Certificate from the manufacturer that the installation will be conducted in conformity with the system requirements by following professional approach.
6. Commitment of the manufacturer for providing Comprehensive 05-Years Warranty and post warranty @ 06.5% of Contracted value for next 05 years.
7. Satisfactory Past performance of the firm for a similar quoted item.
8. Sufficient Technical and Engineering capabilities of the firm (attach a list of technical and engineering staff, special testing equipment/calibration/ repair tools for MRI system)
9. Submission of valid legally enforceable authorization letter of manufacturer assuring full guarantee and warranty obligations as per enclosed manufacturer authorized form with the bid document.
10. The products offered from foreign countries of USA, Europe and Japan shall be eligible to participate and must bear FDA510k and CE standard,

respectively and those products should be marketed world widely. (The product manufactured and marketed for certain region shall be knocked down).

11. Infrastructure for execution of after sales services mentioned by the bidder shall be evaluated for its suitability as per provisions given in specifications and other requirements detailed in the technical specifications of the bidding documents.

12. The firms shall also declare the make, model, country of origin of all accessories to be provided with the equipment.

13. The Procuring Agency has the right to inspect the premises of bidder to inspect the setups ensuring proper after sales services.

MANUFACTURER WARRANTY/ TERMS & CONDITIONS:

1. The manufacturer will undertake to maintain the equipment during the period of warranty which shall be for five years from the date of full functional commissioning with all specified parameters and shall cover labor and parts for all equipment supplied / stated in the contract including non-proprietary parts, accessories, transducer, batteries etc. The manufacturer will also undertake to provide the availability of spare parts for next five years and confirmation of after sales services through its sole agent or directly.
2. The manufacturer will provide Performance Guarantee for the period of warranty, in the form of Bank Guarantee equivalent to 5% of the value of the Contract.
3. The manufacturer will provide undertaking that the magnet is manufactured in USA/Japan or Western Europe.
4. The manufacturer will sign the Contract Agreement along with its Local agent for ensuring prompt after sales services.
5. The Warranty will start from the date after proper installation, as per contracted specifications and handing over of system.
6. The maintenance will be the responsibility of the manufacturer and the agent. An annual optimal uptime of 95 % is considered as acceptable level of performance.
7. Software and hardware up gradation of the computing system should be carried out as available during warranty period as recommended by the manufacturer.
8. Manufacturer/ Supplier shall be responsible for rectifying with all possible speed at their own expense any defect or fault in the system which may develop at any time during installation, commissioning period.
9. The Manufacturer will guarantee the availability of spare parts and accessories for the system for ten years as per service agreement.
10. The firm will bound to execute the installation/ maintenance according to the installation/ service protocol and will replace the components/ kits recommended by the manufacturers for installation and Periodic Preventive maintenance.
11. The scheduled preventive maintenance shall be in accordance with Service Protocol recommended/ advised by the manufacturer.

	<p>12. The manufacturer will connect the system to their Remote Diagnosis and Service Centre via modem for pick-up early faults at no cost to the hospital.</p> <p>13. The manufacturer/ supplier will be responsible for preventive maintenance of equipment as per manufacturers' Service Manuals and shall keep a check for electrical / magnetic / temperature and humidity conditions. Such a check should be made monthly and record should be maintained in the log book of the hospital.</p> <p>14. The manufacturer will certify that the system will be used for continuous scanning/ examination purposes for at least two working shifts (at least from 8.00am to 10.00pm) without deterioration of performance and other parameters</p> <p>PRE-REQUISITE:</p> <p>1. The firms must quote their leading brands from the above mentioned origins with the proven past performance nationally and internationally.</p> <p>2. The firm must possess its related back up support services including trained engineers, workshop facilities, spare parts availability and repair/calibration tools etc.</p> <p>3. The firm will submit the details regarding managerial, engineering, history of past projects, testing tools, key engineer's qualifications and their relevant trainings related to MRI Scanner etc. which will be verified by the technical team to access its qualification for determining the eligibility. Only the qualified eligible firms will be evaluated further as per evaluation criteria.</p> <p>4. Similar one unit of 1.5T MRI must be installed and enjoy good reputation in Pakistani and/or Asian market for minimum one year. The quoted model should be developed/ produced by the manufacturer not earlier than five years for high tech equipment (which will be counted from the date of its certification).</p> <p>5. MRI system the manufacturer will provide the Warranty; local agent's Warranty will not be acceptable. The manufacturer will further certify that in case of change of its agent, it will provide after sales services itself or through their newly appointed agent.</p> <p>6. The firms shall quote make and models, country of origin for each main equipment, accessories and allied equipment also.</p>
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3.	<p>WHOLE BODY MULTISLICE (128-SLICES) COMPUTERIZED TOMOGRAPHY SCANNER:</p> <p>GANTRY System should be capable of Acquiring /Generating 128 slices per gantry rotation in real time. Gantry bore / aperture to be at least 70 cm or more. Minimum gantry rotation time to be at least 0.35 seconds or better, for 128 slices per 360 degree rotation, for all applications.</p> <p>All the firms should quote their latest model scanner with shortest rotation</p>
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time Breath holding time 05 sec or less in cardiac scan
System should be able to acquire helical and sequential scan with the gantry tilted from the vertical.

Gantry tilt range must be + 30 degree.

Maximum scan field of view to be at least 50 cm. For Paeds & Children the system should be able to reduce the field of view to 250 mm.

Minimum slice thickness 0.625 mm or better in Helical mode.

Dual Control (including tilt,) of gantry and table from the gantry-housing and console.

TUBE

Heat storage capacity of at least 7 MHU or better. Generator output of up to 600 mA or more.

Active collimation during scanning

GENERATOR

High frequency power generator with minimum power of at least 70 KW or more should be capable of variable kV setting in steps from 80 to 135/140 KVP

should have ability to vary the power (mAs) automatically in steps Real-time dose reduction hardware / software and with ECG modulation Iterative dose reduction must be offered.

Low contrast detectability (LCD) calculated on a CATPHAN 20 cm, of 5 mm resolution with a CT No. of 3 HU (0.3 %) or better, contrast difference

Scan Length of at least 1.8 meters or more of helical or axial scan in a single acquisition. Maximum Scan Time 100sec. or better.

DETECTORS

Solid state crystal / ceramic detectors with conversion efficiency (x-ray to signal strength) of nearly 98% latest technology.

Isotropic voxel size of 0.35 mm or better, in all three axis

Minimum 64 Detectors and detector electronics capable of providing 128 slices per gantry rotation

Detectors width 38 mm or more.

COUCH

Dual motorized control (from console and gantry) of table movements in horizontal and vertical axis.

Maximum weight allowed on the couch up to 200 kg or more Horizontal movement speed up to 100 mm per second.

Single acquisition scan range of at least 1.8 meter

Scan with at least 0.25 mm accuracy / reproducibility on a 200 kg patient.

Lateral moment table

CONSOLE COMPUTER

System architecture and operating system must be based on latest technology

(64 bit RISC or Dual Xenon Processor PC) original.

Multitasking and parallel processing CPU system.

At least 8 GB RAM or more

Hard disc capacity for image storage of at least 500 GB or more.

Capable of storing at least 3000 raw data files / rotations or 700 GB raw data / 450000 images in 512 x 512 format

Reconstruction of at least 25 images FRAMES per seconds or better at 512 x 512 matrix. Image area display matrix dimensions (1024 x 1024)

Console color monitor (X 02), LCD of at least 19 inches, medical grade with maximum viewing angle

DVD and CD writer CONSOLE SOFTWARE

All the latest whole body & cardio-vascular software should be supplied as standard which is available at the time of shipment original with their part No of company.

USER INTERFACE SOFTWARE True isotropic volume acquisition

Prospective and retrospective ECG gated acquisition

Variable Delay algorithm like fixed percent delay (FPD) and fixed offset delay (FOD) or

better, for selection of period of least motion in cardiac cycle (temporal resolution of 44 milli second or less will be preferred)

Automated contrast media bolus tracking software.

3D RECONSTRUCTION DISPLAY ORIGINAL COMPANY SOFTWARE.

- a. Maximum and minimum intensity projections
- b. Multiplaner and curved planer reconstruction
- c. 3D shaded surface display
- d. 3D volume rendering software
- e. 3D virtual endoscopy, colonoscopy and bronchoscopy
- f. 3D cone beam correction.

CT angiography

Basic Comprehensive Brain perfusion analysis

Image reconstruction Automatic real time dose adjustment according to the body attenuation i.e. core 4D dose/longitudinal dose workstation/ 40 boost/ sure exposure 3D/ organ specific dose modulation or similar.

- a) Artifact reduction algorithm
- b) Automatic control of tube current over high and low attenuation areas for patient dose reduction software for low dose to patient original / certified.
- c) ITERATIVE DOSE REDUCTION SOFTWARE.
- d) Bone removal software.
- e) Metal artifact reduction software
- f) Fat index software
 - g) Dental CT
optimal dual energy to be separately quoted

WORK-STATION- 03 in number/ thin client server (work station with 03

license users)

Independent, automatic multimodality, fully functional. All companies will supply the

same manufacturer's work-stations that they provide world-wide as a standard. Work-stations will be from manufacturer of CT to ensure similar work flow. Third party work-stations not accepted.

High speed link to operator console on DICOM network

System architecture and operating system

- a. Dual processor Xeon
- b. 2.66 GHz or more speed
- c. 512 cache or more
- d. Graphic card and network card

Original Licensed software: Window XP/7/8 or Linux, MS Office 2013, Norton / equivalent antivirus (current and upgradeable for at least for the time of warranty)

Should have at least one high resolution LCD monitor (medical grade as recommended by the manufacturer) of 18 inch or more

DVD RW (super-drive will be preferred)

DICOM-3 viewer with universal PC display capability (licensed)

WORKSTATION SOFTWARE (original with certificate) with thin client, server with three concurrent users).

- a. All the latest available cardiac and whole body software will be provided by the vendor as standard, including reporting packages.
- b. Software up-gradation of all existing applications for at least next 05 years will be provided free of cost.
- c. Following software will be provided at the workstation of the same origin as are being used in USA/EUROPE & JAPAN. 3D Reconstruction display.

- a. Maximum and minimum intensity projections
- b. Multiplaner and curved planer reconstruction
- c. 3D shaded surface display.
- d. 3D volume rendering software
- e. 3D virtual endoscopy, colonoscopy with lumen / fillet view /electronic cleansing / auto segmentation of the colon and bronchoscopy

CT Angiography

- a) Advanced coronary vessel analysis with Auto Labeling /center line analysis Plaque Analysis /Valve Analysis.

Calcium scoring with ECG / VCG gating and prospective / retrospective reconstruction Advanced complete cardiac package including functional analysis with automatic bone removal software.

Comprehensive Cardiac Analysis Application Including single click cardiac segmentation. Advanced peripheral / general vessels analysis Lung nodule detection and analysis Brain perfusion analysis Latest dedicated software for liver imaging with auto segmentation in single click etc.

comprehensive

Fluoroscope:

Fluoroscopy with real time imaging and display of at least 8 frames/sec with required hardware & software. One high resolution in-room TFT monitor of at least 15 inches or more on mobile base/ceiling mounted.

All the firms should provide the life time registered software with part number & products keys / password of all above CT software's original along with CDs and backup for installation.

UPS 3 KVA (x 03), Branded, dry battery capable of providing 20 minutes of back-up for workstations (MG, APC, MC, Chloride, Riello, Emerson). The dry batteries will be included in company warranty.

Heavy duty Laser black and white printer (qty: 3) A4 /letter size 2400 dpi or higher, two paper trays for A4/ letter size media, (HP, Lexmark, Xerox, CANNON) network-ready DICOM

DICOM 3 ready (multi-vendor and multimodality compatible for send, receive, achieve, retrieve and print, on main console and workstations).

UPGRADE-ABILITY

All vendors will quote their latest and best system.

The system should have a software upgrade route to higher versions with undertaking of

above two by the principal manufacture, that is their latest version been used in USA/EU &

Japan.

POWER REQUIREMENT

Three phase with line voltage of 380-440V, 50Hz.

ACCESSORIES

13.1 Programmable, dual head power injector with flow/volume and temperature control.

Mounted on mobile base, with 500 syringes of 150 ml capacity and connecting tubes (Medrad, Medtron/Mallen, Nemoto)-

DICOM 3 ready dry laser camera / imager, Multi-size up to 14 x17 in. (Agfa, Fuji, Kodak/Carestream, Konica) for black and white printing on films including 5000 films.

FILM VIEWER (x 08) for images up to 14 x 17 inch with variable light control and shutters for control of viewing area, with 04 x 1 format

MEDICANVAS, MAVIA

On-line sine wave UPS for whole CT suite, with a minimum back-up time of 30 minute on full load including air-conditioning system,

Two split Air conditioners Two Ton each for UPS room office and waiting area lights/fans etc.,

Protection devices: Lead aprons (06) with hangers, Lead-gloves (06 pairs), Lead goggles

(03) Thyroid Shields (03) all 0.5 mm lead equivalent European & Japanese. Lead glass for control room (5 x 3 feet), 0.5 mm lead equivalent.

	<p>Standard set of Phantoms for calibration of CT</p> <p>Pediatric scanning package - software and hardware original. Cardiac defibrillator,</p> <p>Dedicated Cardiac Monitor for synchronize with cardiac scan.</p> <p>Pulse oximeter ECG machine, multichannel (three channel) Cardiac Resuscitation trolley completely equipped with all necessary items.</p> <p>TABLE ACCESSORIES – Table pads, arms rest, patient restraint kit, IV pole, infant cradle, flat head holder, ceiling mounted hand holder patient (original accessories from the vendor)</p> <p>Digital Transcription system for reporting (hand held units – x 03, and Complete steno-type desktops unit (x 02)</p> <p>SITE PREPARATION/INSTALLATION:</p> <p>Complete Site renovation of CT, Console and UPS room, including lead shielding of the CT room and doors, Air-Conditioning, False ceiling, painting, Antistatic flooring, Electrical DB, Earthing and Power cable from Main Transformer / Hospital LT Panel Will be the responsibility of the supplier. The installation will be a turnkey project and any modification in the existing site will be the responsibility of the firm. The firm will be responsible for complete interface free installation keeping in view the requirement and recommendation of manufacturers and its surroundings to ensure artifacts examinations/procedures.</p> <p>TRAINING: Requirement to be defined by the hospital .</p>
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4.	<p>WHOLE BODY CT SCAN MACHINE 16-SLICE</p> <p>GENERAL: Latest Generation Whole Body CT Scanning machine for general purpose, multi-slice technology of 16-Slice per rotation with helical/spiral scanning capabilities.</p> <p>GANTRY: Gantry Bore diameter 70 cm or more. Tilt at least + 30o from the normal position.</p> <p>Minimum scan length of the table should be 1500 mm. Spiral scan duration upto 100 sec. FOV: Maximum field of view to be 50cm.</p> <p>X-RAY GENERATOR:</p>
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The X-Ray generator should be of 50 KW or more.

High frequency type generator.

KV range selectable between 80KvP and 135kVP or more. Current range of 20mA to 400 mA or more.

ROUTINE SCAN TIME:

0.5 Second or less for 360 degree scan.

DETECTORS:

Should be ultra fast solid state / ceramic detector, compatible with multi slice CT scanner.

Low contrast detectability of 5mm at contrast difference of 3HU(0.3%).

SLICE THICKNESS / COLLIMATION:

Multiple slice thickness options, selectable with minimum slice thickness of 0.625mm to or better.

X-RAY TUBE:

Anode heat storage capacity should be at least 5.0 MHU or equivalent.

COOLING SYSTEM:

Water to water / oil / air heat exchanger for the dissipation of heat generated in the gantry.

TABLE:

Motorized table with weight bearing capability of 180 kg or more.

HELICAL MODE:

Full range of all helical / spiral studies / capabilities should be included.

SYSTEM COMPUTER:

Quad Core Xeon Processor 2.33GHz/64 Bit RISC or better with compatible software. System architecture and operating system must be based on latest capacity.

Multitasking and parallel processing CPU system with 64-bit word.

Hard drive capacity should be 300 GB or more. Storage capacity should be 200,000 images or more.

Access to raw data files and images should be available.

Image zoom, pan, evaluation, measurement and annotation facilities should be present. Image reconstruction speed of 16 images / sec for 512 x 512 matrix.

Real time MPR / Multi-planner reformatting.

DVD/CDR/MOD storage device (re-writeable) should be available.

Compatible keyboard.

OPERATOR CONSOLE:

High resolution flicker free LCD 19" or more color monitor of 1024 x 1024 or better display matrix with keyboard and mouse control.

Intercom for patient monitoring and instructions.

CT ANGIOGRAPHY:

Injector required for CT Angiography along with compatible software should be available.

3-D IMAGE RECONSTRUCTION:

Software should be available in main console.

FOLLOWING LATEST FEATURES/SOFTWARE ARE REQUIRED ON CONSOLE:

Pediatric scanning system to reduce radiation dose to the children.

Perfusion CT for stroke evaluation.

Contrast media synchronization software.

Full Color Volume Rendering 3D at Console and workstation.

ISOTROPIC volume Acquisition at Console. CT Angio both at Console and workstation.

Vessel Stenosis Analysis at Console and workstation. 3D Surface Rendering at Console and workstation.

Curved Planner Performance at Console.

Virtual Endoscopy/Colonoscopy/Bronchoscopy at workstation and console.

Cerebral Blood Flow/Head Perfusion at Console and workstation. Lung Volume Analysis Software.

Pediatric Scanning Package.

Fly Through Software at workstation and console.

CT Fluoroscopy with real time imaging and display at least 6 frames / sec with

required hardware and software. One high resolution TFT monitor 15" or more in CT room on mobile base or ceiling mounted.

Bone mineral density (Optional; separate price)

ITERATIVE NOISE REDUCTION SOFTWARE:

Mottle artifact reduction software

Fat index software

NETWORKING AND DICOM FEATURES:

DICOM Send / Receive.

DICOM Query / Retrieve.

DICOM print.

DICOM Get work list.

POWER REQUIREMENT:

Three phase with line voltage of 220, 50Hz.

ACCESSORIES:

Patient observation and monitoring camera (CCTV).

Infant cradle, axial head folders, security straps, arm rest, table cushion, IV Pole, phantoms and phantom petitioners.

Separate DICOM-3 compatible, workstation (all the companies shall provide the workstation which is supplied by them in USA, Europe and Japan) for Doctor's office providing facilities for image viewing, analysis and reporting with 18" or more LCD

color monitor.

It should have software for the quantitative evaluation of brain perfusion, 3-D volume and surface rendering and vessels stenosis analysis software.

Lead glass 5 x 3 feet.

Programmable power injector with flow/volume and temp control. Mounted on mobile base with 200 syringes of 150ml capacity and connecting tubes (Medrad, Angiostat).

Broad band connectivity for remote diagnosis.

Protection devices:

Lead aprons (03) with hangers, lead gloves (03 pairs) (0.5mm Pb. equivalent, weight).

LASER IMAGING SYSTEM:

Up to 14 x 17" film. Dry processing type printer. DICOM-3 compliant.

UPS FOR CT SCAN SYSTEM:

Compatible full load online sine wave UPS with minimum 10 minutes back up time.

IGBT based with isolation Transformer.

SITE PREPARATION:

Complete Site renovation of CT, Console and UPS room, including lead shielding of the

CT room and doors, Air-Conditioning, False ceiling, painting, Antistatic flooring,

Electrical DB, Earthing and Power cable from Main Transformer / Hospital LT Panel will be responsibility of the supplier. The installation will be a turnkey project and any

modification in the existing site will be the responsibility of the firm. The firm will be responsible for complete interface free installation keeping in view the requirement and recommendation of manufacturers and its surroundings to ensure artifacts examinations/procedures.

TRAINING:

Requirement to be defined by the hospital.

System should be upgradeable to 32 slices per gantry rotation

5.	<p>CT-SIMULATOR</p> <ol style="list-style-type: none"> 1. GANTRY <ul style="list-style-type: none"> • Gantry bore to be at least 85 cm or more. • Minimum gantry rotation speed to be at least 0.5 sec for 16 slices per 360 degree rotation or better. • System should be able to acquire helical spiral scan. • Maximum field of view to be 65cm or more. • Minimum slice thickness for 16 slices: 0.60 mm or better. 2. TUBE <ul style="list-style-type: none"> • Heat storage capacity of at least 7.0 MHU. • Anode heat dissipation of at least 1000 kHU/minute. • Generator output of at least 600 mA or more. 3. GENERATOR & DETECTOR <ul style="list-style-type: none"> • High frequency type. Maximum power of at least 70 kW or more. • Dose reduction hardware/software. • Calculate patient dose in milli-Gray preferably before axial acquisition. • Low contrast detectability (LCD) calculated on a catphan CT phantom of 3mm resolution with a CT Number of 3 HU (0.3%) contrast difference. • Scan length of at least 1.7 meters of helical or axial scans in a single acquisition. 4. TABLE <ul style="list-style-type: none"> • The Flat Carbon Fiber Table Top. • Single acquisition scans range of at least 1.7 m. • Scans with at least 0.25 mm accuracy on a 180 Kg patients or more. 5. CONSOLE COMPUTER <ul style="list-style-type: none"> • System architecture and operating system must be based on latest technology. • Multi tasking and parallel processing CPU system. Dual Xeon processor. • At least 200 GB of storage space or more. • Capable of storing at least 3000 raw data files per rotation or 100 GB raw data. • Spiral reconstruction at 20 images/frames per second or better at 512 x 512 matrix. • Console monitor of color 19" LCD type. Dual monitors to be
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provided one for acquisition and the other for display.

- DVD and CD writer .

7. ADDITIONAL WORKSTATION (Same as recommended by manufacturer and supplied Worldwide by them) Qty-2

- High-speed links to the operator console on DICOM network.
- System architecture and operating system must be based on latest Dual Xeon processor of 2.6 GHz with 512 cache.
- Should have one Hi-resolution LCD/TFT screen of 19 inch or more.
- CD / DVD writer
- DICOM viewer with universal PC display capability (licensed).
- Color laser printer, A4 size, and high resolution.

8. SOFTWARES

- Full color volume rendering 3D both at console and workstation.
- True isotropic volume acquisition both at console and workstation.
- CT Angio both at console and workstation including Coronary Angiography. (Optional)
- Vessel stenosis analysis at workstation.
- 3D surface rendering both at console and workstation
- Curved planer reformation at console.
- Contrast media based synchronizing software at console.
- Bone mineral density with phantom at console.
- Virtual endoscopy / colonoscopy / bronchoscopy at workstation. (Optional)
- Brain perfusion both at console and workstation.
- Dental CT at workstation / console. Optional
- Calcium scoring (coronary) with ECG/VCG gating and capability for prospective and retrospective reconstruction complete cardiac phase editing and function analysis. (Optional)
- Pediatric scanning package.
- Vessel Plaque analysis software for differentiating between hard and soft plaque automatically. (Optional)

- Lung nodule analysis
- ITETRAIVE DOES REDUCATION SOFTWARE:
- Mattel artifact reeducation software
- Fat index software

NOTE: Console and workstation should be capable of independent working.

8. DICOM 3 Capability

- DICOM 3 Capability for Send, Receive, Archive, Retrieve and Print.

9. POWER REQUIREMENT

- Three phase with line voltage of 220 V, 50Hz.

10. Multi slice CT Fluoroscopy

- Multi slice CT Fluoroscopy with real time imaging and display at least 8 frames / sec with required hardware / software. One high resolution in room LCD monitor of at least 15 inches or more on mobile base / ceiling suspended.

11. ACCESSORIES

- DICOM compatible Dry Laser/Thermal camera, multi size up to 14" x 17".
- DICOM Film Printer/ Imager.
- Set of Moving Lasers (at least 3) with its software and its connectivity license with your TPS.
- On line compatible sine wave UPS for whole system with a minimum back up of 30 minutes on full load.(Emersion, Riello, APC,G.E.)
- Protection device (Lead aprons 04 with hangers, Lead Gloves 04 pairs, 0.5 mm Pb Equivalent light weight).
- Lead glass for control room 5x3 feet 0.5 mm Pb. Equivalent.
- Dual head programmable Power injector with flow/volume and temp control capable of simultaneous injection of both contrast and saline. Mounted on mobile base with 100 syringes of 150 ml capacity and connecting tubes.
- RT models of CT Scanners.
- Standard set of phantoms for calibration of CT.
- X-ray markers.

SITE PREPARATION:

Complete Site renovation of CT, Console and UPS room, including lead shielding of the

CT room and doors, Air-Conditioning, False ceiling, painting, Antistatic flooring,

Electrical DB, Earthing and Power cable from Main Transformer / Hospital LT Panel will be responsibility of the supplier. The installation will be a turnkey project and any

modification in the existing site will be the responsibility of the firm. The firm will be responsible for complete interface free installation keeping in view the requirement and recommendation of manufacturers and its surroundings to ensure artifacts examinations/procedures.

TRAINING:

Requirement to be defined by the end user.

System should be upgradeable to 32 slices per gantry rotation

6.

DIGITAL HIGH-END COLOR DOPPLER

Color Doppler with more than 192 transmitting channels with 12-Bit A/D Conversion Fully Digital Beam former having 2D / M-Mode and Doppler Facilities, (PW, HPRF, & Color Flow Imaging) with High Resolution Imaging Doppler Signal Quality; having DICOM Compatibility and Upgradeable to CW and 4D Imaging in Convex, Linear and Endocavity Probe.

- 1) B-MODE Specification:
 - a) Sector Scan Angle Variable in Four Steps.
 - b) Viewing Depth: 30 cm Minimum (Both in B & W and Color).
 - c) Frame Rate: 1000 f/sec or more
 - d) Built-in cine loop with ability to vary reverse and slow motion of display; Internal Memory 2000 or more Color Images or more/ Equivalent.
 - e) Real time and Freeze Image Magnification at least 10X or more with panning for Real, Freeze and Memorized Images.

- 2) M-MODE SPECIFICATION:
 - a) Magnification: X2 or more.
 - b) Sweep Speed: Slow, Medium and Fast.
 - c) Color Display of M-Mode.

- 3) D-MODE SPECIFICATION:
 - a) Pulse-Wave Doppler Measureable Velocity Range.
 - b) HPRF Doppler.
 - c) CONTINUOUS-WAVE DOPPLER:
 - Measurable Velocity Range: Steerable.
 - Must have Doppler Beam Steering and Bi-Directional Stereo-Audio.
 - d) Colorized Spectrum Display.
 - e) Automatic Baseline and Velocity Range Control.
 - f) Live Measurements for Doppler Spectrum.
 - g) Min. detectable velocity range 0.05/cm or less for low flow velocity blood vessels.

- 4) COLOR DOPPLER MODE SPECIFICATIONS :
 - Both CW and PW Doppler must be Continuous Steerable in the Color Blood Flow Image Mode in Real Time.
 - 2D Image with Color, CW and PW Doppler.
 - Windows based System for easy usage with Programmable Control Panel Keys.
 - Tissue Harmonic Imaging with 4THI or more Frequency.
 - Power Doppler.
 - Triplex Mode for Simultaneous Display of Color B/M and D-Mode Displays.
 - 200 db system dynamic range or more.

- 5) MEASUREMENT PACKAGE:

To provide Comprehensive Software Package for Measurement of Distance, Circumference, Area, Time Depth, ANGLE, IMT, Velocity, Frequency, Heart Rate, Volumes, Nuchal Thickness/ Measurement Software to be Provided as a Standard.

- 6) SYSTEM COMPLETE WITH FOLLOWING FACILITIES AND ACCESSORIES:

- 19-Inches Minimum TFT / LED Color Monitor, with Resolution 1280 x 1024 Pixels minimum.
 - Foot-Switch.
 - 4 Active Transducer Connector for Tran thoracic Probes DVD / CD Drive for Image Storage to be Built-in to the System.
 - 500 GB or more Hard Disk Drive to be Built-in to the System.
 - Built-in DICOM Compatibility. (3.0 with all components)
 - Touch Command Screen Control at least 10-inches LCD / TFT.
 - Full DICOM (Upgradable)
- 7) UPGRADEABILITY :
- System Software must be Upgradable.
- 8) STANDARD PROBES :
- 2 – 6 MHz Multi-Frequency Single Crystal Convex Probe for B/M/CDI/PW and Shearwave Elastography.
 - 5-9 MHz Multi-Frequency Linear Probe with shearwave elastography.
 - TVS/ENDOCAVITORY Color PROBE
 - 7-14 MHz Multi-Frequency Linear Probe for B/M/CDI/PW
- (OPTION)
- NOTE: Probes should be of same Country of Manufacturer & Origin as main unit
- 9) STANDARD RECORDING DEVICES:
- Thermal Paper Printer with fifty Rolls of Paper (Black & White). WITH HD
 - CINEWAVE UPS Online with 30 minutes back up time for the System.(IMPORTED (EUROPE/USA/JAPAN)
- 10) Tissue Doppler Imaging Mode.
- 11) Pure Wave / Pulse Inversion / Differential Tissue Harmonic Imaging to Enhance Effective Wide Band Frequency Range to provide Simultaneously Spatial Resolution, Contrast Resolution and increased Penetration using Two Transmission Pulses at Different Frequencies Simultaneously and Reception at Harmonic as well as Differential Component.
- 12) Auto Image Optimization / Quick Scan Imaging for Automatic STC / GAIN and Doppler Spectrum Adjustment with Optimal Image Quality by using One Touch Operation.
- 13) B-Flow / Dynamic Flow Imaging / E-Flow.
- 14) Trapezoid Imaging / Virtual Convex Imaging with Linear Probe.
- 15) Compound / Aplipure Imaging for THI/both Frequency Compounding and Spatial Compounding in B/W and Color Mode.
- 16) Panoramic / SIESCAPE / Logic view Imaging with Measurements.
- 17) TISSUE CONTRAST ENHANCEMENT SOFTWARE/SPECTRAL REDUCTION
- 18) N-Sight / Adaptive Suppression / Precision Imaging /Cross beam to Enhance B-Mode Imaging, Xress/Ccare/or equivalent Detailed in Layers and Boundaries and Sharpened Outlines of the Lesions and reduce Cluttering.
- 19) Micro CPA / Superb Micro Imaging/vascular enhancement/B flow with Color/spectral to Clearly Show Blood Flow in tiny Vessels,
- 20) Shear wave Elastography with Quantification for body Organs specially

	<p>Liver with Convex & Linear Probes to visualize Tissue Stiffness by Generating Images through Shear Wave Propagation.</p> <p>21) Live Strain Rate Elastography with Quantification for Body Organs Specially Breast to Visualize Lesions.</p> <p>22) Contrast Harmonic Imaging Upgradable.</p> <p>23) Fusion Imaging of CT / MRI 3D Volume DATA to Synchronize with Ultrasound Imaging. Complete with Hardware /NEEDLE NAVIGATION WITH TRACKING SYSTEM & Software Upgradable. --OPTION</p> <p>24) Voltage : 220V – 240V, 50 – 60 HZ</p>
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7.	<p>DIGITAL MEDIUM RANGE COLOR DOPPLER</p> <p>Color Doppler with more than 192 transmitting channels with 12-Bit A/D Conversion Fully Digital Beam former having 2D / M-Mode and Doppler Facilities, (PW, HPRF, & Color Flow Imaging) with High Resolution Imaging Doppler Signal Quality; having DICOM Compatibility and Upgradeable to CW and 4D Imaging in Convex, Linear and Endocavity Probe.</p> <p>1) B-MODE Specification:</p> <p>a) Sector Scan Angle Variable in Four Steps.</p> <p>b) Viewing Depth: 30 cm Minimum (Both in B & W and Color).</p> <p>c) Frame Rate: 1000 f/sec or more</p> <p>d) Built-in cine loop with ability to vary reverse and slow motion of display; Internal Memory 2000 or more Color Images or more/ Equivalent.</p> <p>e) Real time and Freeze Image Magnification at least 10X or more with panning for Real, Freeze and Memorized Images.</p> <p>2) M-MODE SPECIFICATION:</p> <p>a) Magnification: X2 or more.</p> <p>b) Sweep Speed: Slow, Medium and Fast.</p> <p>c) Color Display of M-Mode.</p> <p>3) D-MODE SPECIFICATION:</p> <p>a) Pulse-Wave Doppler Measureable Velocity Range.</p> <p>b) HPRF Doppler.</p> <p>c) CONTINUOUS-WAVE DOPPLER:</p> <ul style="list-style-type: none"> - Measurable Velocity Range: Steerable. - Must have Doppler Beam Steering and Bi-Directional Stereo-Audio. <p>d) Colorized Spectrum Display.</p> <p>e) Automatic Baseline and Velocity Range Control.</p> <p>f) Live Measurements for Doppler Spectrum.</p> <p>g) Min. detectable velocity range 0.05/cm or less for low flow velocity blood vessels.</p> <p>4) COLOR DOPPLER MODE SPECIFICATIONS :</p> <ul style="list-style-type: none"> - Both CW and PW Doppler must be Continuous Steerable in the Color Blood Flow Image Mode in Real Time. - 2D Image with Color, CW and PW Doppler. - Windows based System for easy usage with Programmable Control Panel Keys. - Tissue Harmonic Imaging with 4THI or more Frequency. - Power Doppler. - Triplex Mode for Simultaneous Display of Color B/M and D-Mode
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Displays.

- 200 db system dynamic range or more.

5) MEASUREMENT PACKAGE:

To provide Comprehensive Software Package for Measurement of Distance, Circumference, Area, Time Depth, ANGLE, IMT, Velocity, Frequency, Heart Rate, Volumes, Nuchal Thickness/ Measurement Software to be Provided as a Standard.

6) SYSTEM COMPLETE WITH FOLLOWING FACILITIES AND ACCESSORIES:

- 19-Inches Minimum TFT / LED Color Monitor, with Resolution 1280 x 1024 Pixels minimum.
- Foot-Switch.
- 3 Active Transducer Connector for Tran thoracic Probes DVD / CD Drive for Image Storage to be Built-in to the System.
- 500 GB or more Hard Disk Drive to be Built-in to the System.
- Built-in DICOM Compatibility. (3.0 with all components)
- Touch Command Screen Control at least 10-inches LCD / TFT.
- Full DICOM (Upgradable)

7) UPGRADEABILITY :

- System Software must be Upgradable.

8) STANDARD PROBES :

- 2 – 6 MHz Multi-Frequency Single Crystal Convex Probe for B/M/CDI/PW.
- 5-9 MHz Multi-Frequency Linear Probe for vascular studies.
- TVS/ENDOCAVITORY Color PROBE
- 7-14 MHz Multi-Frequency Linear Probe for B/M/CDI/PW (OPTION)

NOTE: Probes should be of same Country of Manufacturer & Origin as main unit

9) STANDARD RECORDING DEVICES:

- Thermal Paper Printer with fifty Rolls of Paper (Black & White). WITH HD
- CINEWAVE UPS Online with 30 minutes back up time for the System.(IMPORTED (EUROPE/USA/JAPAN)

10) Tissue Harmonic imaging without contrast with 4 harmonic frequencies.

11) Pure Wave / Pulse Inversion / Differential Tissue Harmonic Imaging or similar.

12) Auto Image Optimization / Quick Scan Imaging for Automatic STC / GAIN and Doppler Spectrum Adjustment with Optimal Image Quality by using One Touch Operation.

13) B-Flow / Dynamic Flow Imaging / E-Flow clarify for low flow vessels imaging.

14) Trapezoid Imaging / Virtual Convex Imaging with Linear Probe.

15) Compound / Aplipure Imaging for THI/both Frequency Compounding and Spatial Compounding in B/W and Color Mode.

16) Panoramic / SIESCAPE / Logic view Imaging with Measurements.

17) Fusion Imaging of CT / MRI 3D Volume DATA to Synchronize with

	<p>Ultrasound Imaging. Complete with Hardware /NEEDLE NAVIGATION WITH TRACKING SYSTEM & Software Upgradable. --OPTION 18) Voltage : 220V – 240V, 50 – 60 HZ</p> <p>SYSTEM MUST HAVE FDA AND CE.</p> <p>COUNTRY OF MANUFACTURING & ORIGIN : USA / EUROPE / JAPAN</p>
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8.	<p>PORTABLE /MOBILE ULTRASOUND</p> <p>Digital Ultrasound scanner with digital beam former System should be capable to handle multi frequency probes from 3.0 MHz to 9.0 MHz or above. Built-in Trolley System.</p> <p>Multi frequency Convex Probe with center frequency between 3 to 5 MHz Multi frequency Linear Probe with center frequency between 5 to 7.5 MHz Biopsy adpoter for any probe Modes: B.M and combination thereof. M. Mode sweep: 4 speed or more. Gray scale: 256 Color Doppler PW and CW Doppler Sensitivity time gain: 8-12 steps Depth: 24 cm or more Focusing system: 3 steps and dynamic Adjustable acoustic power Frame rate: 80 frame / sec or more Keyboard: Alpha numeric with track ball / Touch pad Tissue Harmonics: Tissue Harmonic imaging Cine memory of 64 frames minimum Post processing: Image inversion, edge/echo enhancement correlation / persistence/Dynamic range/Gamma Curve. Image magnification 4x or more in real time. Monitor: 15" LCD / TFT Two probe connectors or more</p> <p>Accessories: 1. Thermal Printer 256-Gray scale (Sony, Mitsubishi) 3. UPS: on line with sine waves 2 KVA with thirty minutes back up time. (IMPORTED) 3. 50 High Density / High Glossy thermal paper Rolls 4. Gel: 20 liters</p> <p>OPTIONALS: Foot Switch Multi-frequency Linear Probe with center Multi-frequency between 5 - 7.5 MHz Biopsy Adaptor for Any Probe Multi-frequency Endocavity Probe with center Multi-frequency between 5 - 8 MHz (90-150 degree)</p>
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9.	DIGITAL MAMMOGRAPHY UNIT WITH STEREO BIOPSY.
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1. **HIGH FREQUENCY X—RAY GENERATOR:**
 - 5 KW
 - 23 — 35 KV (1 KV STEPS) ,better will be preferred
 - mAs range 5 - 500 mAs.
 - Exposure Time 4- 6sec
 - Exposure Mode: Manual & Automatic (AEC).
 - Automatic Exposure mode should have automatic selection of Track, filter, kv and mAs. .
2. **C ARM** with source to detector distance 65 cm or more.
 - Motorized Isocentric rotation
 - User defined Motorized compression device with safety release.
 - Rotation 160- 180°
3. **X-RAY TUBE WITH ROTATING ANODE**
 - Tube type should be rotating with dual material anode preferred material would be Molybdenum, Rhodium , Vanadium Tungstun . Tube should comprise of all this material.
 - Four focal spot 0.1 & 0.3 and dual focus in each track.
 - Anode heat storage capacity 162 kHU or better will be preferred
 - System should have separate monitoring software for tube overload protection
4. **COLLIMATION**
 - Manual & Automatic.
 - Automatically switching light centering device.
 - Collimators should have at least two filters Molybdenum 0.03mm or better, and Rhodium 0.025mm.
5. **DIRECT / INDIRECT CONVERSION FULL FIELD FLAT PANEL DETECTOR 24 X 30 CM FORMAT.**
 - DEPTH 14-BIT or more
 - PIXEL PITCH: 100 X 100 μ M and RESOLUTION: 3062 X 2394 PIXELS or better
 - DQE: 60 % or more
6. **REMOVABLE GRID {RATIO 5:1, 30 LP/MM or better}**
 - Should have motorized Grid
 - Should have Breast support for Geometric Magnification.
7. **ACQUISITION WORKSTATION:**
 - Intel /AMD Dual Core HP or Equivalent brand from original Manufacturer workstation.
 - Memory should be 2 GB RAM or better
 - Should be able to store up to 25,000 images or more.
 - 3 MP LCD Monitor Medical Grade.
 - Compression force display
 - Rotation Angle Display.
 - Breast Thickness display with Thickness Compensation Algorithm.
 - Processing Features should include:
 - Dose Calculation information /AGD [Average Glandular Dose)
 - Zoom & Pan
 - Magnifying glass
 - Flip, rotation of image.
 - Inversion
 - Measurement and Annotation Tools.

- Should have online/ built-in UPS for avoiding loss of information (Recommended built in UPS from original Manufacturer for system safety and reliability)
- Emergency Stop button

8. REPORTING WORKSTATION

- Latest workstation from the original manufacture with the undertaking that the same workstation having supplied with this machine all over the world and should be manufactured by the original Manufacturer of Digital Mammography system.
- 2 Intel/AMD Xeon or Equivalent processor for High Density image processing.
- Storage HDD 2 TB or more. _
- 32 GB RAM.
- DVD,/RW optical Device.
- Workstation should have 19" 1 MP Medical for Patient and Report Management.
- Dual 5 MP 21" Medical Grade Monitor for image Review.
- The work station should be multimodality and should be able to review and analyze from other breast imaging modalities from ultrasound and MRI for Comprehensive Diagnosis.
- Dedicated Measurement tool for distance, area and angle measurement.
- Should have free continuous zoom and quadrant zoom functions with panning and navigation zoom function.
- Integrated reporting tool.
- Zoom and Pan images.
- Magnifying glass
- Invert and graphical annotation through shapes.
- Rotate or flip
- Should have ability to display Computer Aided Detection (CAD) markers for micro- calcification and markers.
- Should have the ability to support CAD supported reports.
- Should have DICOM functions (Print, Storage. Query & Retrieve, modality worklist)

9. STEREO BIOPSY DEVICE

- Stereotaxy device should be easy to install and should be able to perform fine needle aspiration, core biopsy, vacuum assisted biopsy or hook wire placement.
- Needle approach should be Automatic and Manual motor driven both.
- Should have Vertical and lateral Approach for easy access to breast lesions.
- Should have three axis in both Vertical and lateral Approach
- Should provide phantom for Quality checks.
- Should also include Stereotaxic positioner and paddle.
- Should include lateral and vertical approach kit and metal guides.

10. STANDARD ACCESSORIES:

- 24 X 30 cm COMPRESSION PADDLES.
- 19 X 23 cm SLIDING COMPRESSION PADDLE.
- 24 X 30 Cm FLEXIBLE & SLIDING COMPRESSION PADDLE
- 19 X 23 cm FLEXIBLE & SLIDING COMPRESSION PADDLE
- WALL MOUNT STAND FOR PADDLES & STEREO DEVICE.
- GRIDLESS DEVICE FOR GEOMETRIC VARIABLE

	<p>MAGNIFICATION 1.5X AND 2X.</p> <ul style="list-style-type: none"> • TWO PAIRS OF COMPRESSION FOOT PADDLE. • X-RAY CONTROL PUSH-BUTTON WITH EXTENSIBLE CABLE. • X—RAY SHIELD FROM ORIGINAL MANUFACTURER INTEGRATED WITH ACQUISITION CONSOLE FOR PROTECTION. • LASER PRINTER CAPABLE OF PRINTING OF 10 x 12 and 14 x 17 FILMS with two packets of films for testing purpose. • Two set of special illuminators for viewing the mammograms. • UPS to run the whole system with minimum 20 min backup • Standard manuals, calibration equipment and quality control devices should be part of the system. • Lead Apron , female and Male should be provided. • 2 magnifying glassy hand mirrors for viewing <ul style="list-style-type: none"> <input type="checkbox"/> Warranty period 3 years <input type="checkbox"/> Renovation of the machine area/room and patient waiting area responsibility of vendor , including fire extinguisher equipment, air conditioning, protection of operator by lead stand with lead glass <input type="checkbox"/> Foreign training of two Teaching Staff of Radiology Department <input type="checkbox"/> Local Training of Two Radiographers <input type="checkbox"/> Application specialist visit on site — at least two visits in first year of installation <input type="checkbox"/> The System should consist of latest software's and should be provision of upgradability to Advance applications. <p>11. SYSTEM UPGRADABILITY:</p> <ul style="list-style-type: none"> • The system should be upgradable to Advance applications 3D TOMOSYNTHESIS.
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10..	<p><u>Proposed Specifications of Bi-Plane Universal Digital Angiography / Neuro-Interventional System.</u></p> <p>Positioning ARMs: One Ceiling mounted and one Floor mounted C--arm with motorized. Real time display of rotation angulations. The C-arms should have the possibility of head to toe coverage of the patient without repositioning the patient. Both-planes should have Flat Detector. Right anterior oblique Left anterior Oblique +/- 100° or more for Floor It -27 to +100 o for ceiling. Cranial / Caudal: Minimum + 45 / 45 O or more for both planes. Rotation speed: 10° / sec. or more in LAO RAO for floor mounted and 8° / sec for ceiling mounted C-arm. Motorized parking for floor and ceiling mounted C-Arms. Integrated, computer-aided collision monitoring Protection Touch sensor Programmable auto positioning of selected angulations. (50 or more programmable positions) Variable source-to-detector distance Motorized gantry rotation for free positioning of system and table», for optimum patient access. The C-arm should maintain FD position, isocenter and projection while swiveling</p>
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gantry around the patient.

PATIENT SUPPORT / TABLE:
 Floor mounted examination table for angiography and interventions
 Motorized height adjustment with variable speed. Floating tabletop with longitudinal and transverse movements
 Left /right pivotal table rotation +/- 90 deg. or more
 Patient weight bearing capacity 200 kg or more. Capability to handle additional load (100 kg) in any table position

Accessories:
 Arm cradles (pair), Unilateral armrest, infusion bottle holder, Instrument tray.

X-Ray Generator
 Microprocessor based high frequency X-ray generator
 Output Power 100 KW. Radiographic rating minimum 1000 mA at 100 KV
 The system should have capability of digital radiography and fluoroscopy
 Continuous/Pulsed fluoro output power of 2 KW or more to ensure good image quality during fluoro at oblique angles
 Shortest Exposure time of 1msec with automatic exposure control

X-RAY Tubes:
 Dual/Triple focus X-ray tubes for both planes with anode heat storage capacity of at least 2.0 MHU or better.
 Liquid bearing technology for longer durability and quiet operation
 Focus 0.3mm, 0.6mm and 1.0 mm or better for triple focus & 0.4 & 0.8 mm or better for dual focus tube.
 Continuous heat dissipation of 2500 W or more.

FLAT DETECTORS:
 The high resolution dynamic flat panel detector with integrated detachable grid especially designed to fulfill the requirements for diagnostic and interventional radiology.
 Large Flat Panel Detector on both planes: size 30 x 30cms or more for both planes.
 Pixel size: 200 um or less.
 Spatial resolution: 2.5 LP/mm or more.
 image acquisition to be done in 14 bit digitization depth.
 Digital imaging system (Acquisition / Fluoroscopy)
 High resolution digital imaging system.
 Acquisition, storage and display in 1024 x 1024 x 12 bits.
 Real time filtering, online edge enhancement, noise reduction (spatial filtration) re-masking, and road map function,
 Dynamic real time Pan/Zoom
 Manual and automatic pixel shift for DSA studies
 Hard Disk/Magnetic Disk Capacity for storage of 50,000 images with 1024 x 1024 x 12-bits matrix
 DICOM 3.0 with standard exchange media
 The system must have Dicom send, Dicom print and Dicom Query / Retrieve facility.
 Digital pulsed fluoroscopy / radiography with 7.5/10 and 15 frames per second in 1024 x 1024 x 12-bits or more for single plane
 Display of scene directory for easy selection of any image or scene from the examination room of control room
 Variable copper filtration during fluoroscopy and acquisition for radiation protection
 The selection of the Cu filters must be automatic by the system based on patient

weight / absorption without any user interaction.

Vessel analysis with determination of degree of stenosis, distance measurement and calibration. The system should have catheter-and sphere calibration

Automatic positioning of the-c-arm corresponding to reference image and preferably vice versa

Simultaneous display of subtracted and un-subtracted fluoroscopy images. single plane and biplane on flat display monitor for both plane

Overlay fade feature i.e. online. Superposition of active fluoroscopy and reference image.

The system must have online image density (gray scale) correction i.e. Automatic online image density correction of dynamic scenes and single images for clear view in the bright and dark areas of the image.

Facility to review previous studies in the examination room from the patients old CD. The system has the capability for retrieval of angio images back in to the digital imaging system from the CDs and/or the network.

Online Digital subtraction angiography (DSA) with frame rates from 0.5 to 6.0 fls selectable.

Flexible pixel shift automatic manual.

Digital rotation angiography in SD effect with 'un-subtracted and dynamic subtracted image display in acquisition with rotating. for acquisition in 1024 x 25 matrix 25 f/s or better in single plane.

The system should display subtracted images during acquisition preferably while rotating.

All controls of digital imaging system must be available in the examination as well as control room.

CD RECORDER

CD drive for automatic digital image storing on CD-ROM for off-line data exchange in DICOM 3 format. The system must archive the images/scenes on to the CD in background

MONITORS FOR THE SYSTEM:

Active Matrix TFT monitors with 1024 x 1280 matrix resolution.

Monitors should be ceiling-mounted in the operating /examination room. The ceiling suspension for monitors in the examination room should have room for six monitors.

Two 19 inches or more active matrix digital TFT monochrome monitors for live images of each plane in the operating/examination room. Brightness of the imaging monitors: 600 cd/m² or more

Two 19 inches or more active matrix digital TFT monochrome monitors for road mapping in the operating/examination room. Brightness of the imaging monitors: 600 cd/m² or more

One 19 inches color display I monitor for display of images of the workstation in the examination room

Four 19 inches active matrix TFT monochrome monitors for live images and road mapping in the control room.

	<p>Brightness of the imaging monitors; 600 cd/m² or more.</p> <p>Additional Workstation: As recommended by the Principals and being supplied worldwide.</p> <p>High Performance Windows/LINUX based Multimodality /dedicated workplace with 2 X Dual Core 3GHz Pentium Processors with minimum 3GB or more. The workstation to be equipped with graphic board to support 3D applications. High performance windows XP based multimodality workplace with 2 x Dual core 3 GHz Pentium processors with minimum 3 GB RAM or more and a minimum disk capacity of 140 GB or more 3D reconstruction SW for universal angiography & neuro applications for the reconstruction of 2D tomograms from the projection images.</p> <p>Interactive 3D reconstruction and visualization in real time of a volume in volume rendering technique, MPR and MIP</p> <p>Features:</p> <p>Display of multiple volumes, to switch between un-subtracted and subtracted mode. Transfer, 3D reconstruction and visualization in one defined protocol within minimum time duration.</p> <p>Different sets of acquisition and reconstruction protocols to meet the requirements for visualization of vessels, bones, clips and coils</p> <p>Reconstruction result can be native and subtracted.</p> <p>Modification of reconstruction area to allow zoom via reconstruction</p> <p>Display of the 3D reconstructed image data in the examination room on a monitor in the main ceiling suspension of angio monitors.</p> <p>Control of 3D-reconstruction SW from the table side control / workstation</p> <p>The workstation should have multi-modality capability on it or on a separate addition workstation in order to display CT/MRI images on it.</p> <p>The Workstation must have the ability to post process DSA images on the SD workstation. If DSA post-processing is not possible on 3D Workstation, then additional workstation for DSA post processing is to be offered.</p> <p>Special package to provide soft-tissue cross-sectional imaging in the interventional suite. it should suite and support neuro-radiologist during interventional procedures in the angiography suite with both endovascular and nonendovascular.</p> <p>This package should provide excellent soft tissue image quality (in 512 matrix) for neuro and body imaging . Neuro images in 512 x 512 matrix are to be reconstruction minimum time. It should be possible to visualize a density difference of 10HU (Hounsfield Units, less preferred) of an object 10mm in size in a Thick-MPR display. (Measured with a CATPHAN CT phantom).</p> <p>Optional (To be Quoted Separately)</p> <p>Option-1 or any other similar / better option:</p> <p>workstation should create visualization and fading between the live / acquired 2D fluoro image and the matching 3D reconstructed image by the workstation for vessels / coil/bone. it should allow to overlay the colored 3D volume</p>
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with regular/acquired fluoro as well as with subtracted fluoro and acquisition series on the display of the workstation. Thus this information is available in parallel to the regular or subtracted fluoro or acquisition.

Option – 2:

Simultaneous display of subtracted and un-subtracted fluoroscopy images for single plane and biplane. Additional display i.e., monitor per plane is to be included and these monitors are to be installed with the remaining monitors in the examination room.

Non availability of optional items shall not be considered as a reason of tender rejection

Any other latest software available with the company should be offered as option.

Accessories Required.

- Surgical shadow-less light ceiling suspended.
- Ceiling suspended Lead Glass for Upper Body Radiation Protection
- Lower body radiation protection flaps.
- 1 x Fully programmable latest model contrast medium injector.
- One Postscript level Network Laser Printer for taking image printouts on paper.
- This printer is to be connected with the Main Digital imaging System. Paper for 500 prints should be delivered with the printer.
- 1000 write-able CDs should be delivered with the system
- Lead Glass Window size 2 x 1_ meter or more. Pb equivalence 2.1mm or better.
- 6 x Pb aprons, double sided. Pb equivalence front 0.5mm; back 0.35mm
- 6 x Thyroid shields and 6 x Pb Glasses
- intercom for communication between control and exam room.
- DICOM Laser Camera with 14-x17 inches cassette formats
- UPS compatible for the whole system with back-up time of 10 minutes for fluoro and cine acquisition.
- 2x firm viewer for images up to 14 x 17 with variable light control and shutters.

TRAINING

Clinical and technical training of two consultants Neuro-Interventionalist / Neuro radiologist abroad in English speaking country for 2 weeks each.

- Training of Angio technician for two weeks abroad / Local at site of equipment
- 1 week local training for two technicians
- 2-visits of application specialist.

SPECIAL TERMS & CONDITIONS

The contracting firm will install the complete system including all the accessories indicated in the specifications within a period of maximum six months starting from the date of establishment of L/C

Vendor will also be responsible for the required transformer. DB, earthing, main switch board and complete electrical wiring including mains cable to the machine.

The warranty period will be two years from- the date of full functional commissioning of the system

including X-Ray tube. Flat Panel Detector, non-proprietary parts etc.

- Shielding of the angio room will be the supplier responsibility
- Renovation of the angio room, waiting area will be the supplier responsibility.
- The complete project will be on a turn-key basis and should meet the

	<p>international standards</p> <ul style="list-style-type: none"> <input type="checkbox"/> The company should offer their latest and top of the line system <input type="checkbox"/> All civil, electrical work inclusive of furniture and cabinets for the angio suite will be supplier's responsibility. <input type="checkbox"/> The warranty should be unconditional and from the original manufacturer; <input type="checkbox"/> The offer should be from Principals. <input type="checkbox"/> Note: Latest hardware and software shall be supplied. <p>Approved Panel: GE Medical Systems, Philips Medical Systems, Siemens AG Toshiba Medical Systems Corporation</p>
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11.	<p>DIGITAL RADIOGRAPHY/ FLUROSCOPY SYSTEM (RF Room)</p> <p>Digital Radiography/ Fluoroscopy unit of high quality digital imaging chain, optimal dose conservation, high patient throughput with over table tube and Flat Panel Detector.</p> <ul style="list-style-type: none"> • The output of the X-ray high-voltage generator should be 80 kW. The X-ray control should use a high-frequency inverter. • The tabletop move approx. 30 cm in the lateral direction. The detector movement covers form edge to edge of the x-ray table. The table tilts should be from the upright vertical position (approx. +90°) to the horizontal position (0°) to the head-down-tilt position (approx. -15°). • The tabletop should be Flat/convex type to allow patient centering. • The startup time should be short. <p>X-Ray Diagnostic Table:</p> <p>Table tilting Tilt range: Upright vertical position (approx.90°) Horizontal position (approx. 0°) Head-down tilt position (approx. -15°) Compression force of the compression cone: 80 N or more Allowable patient mass: Max. 150kg minimum.</p> <p>X-Ray High Frequency Generator:</p> <p>Ratings High-voltage generation method: Inverter method Short-time ratings: 800mA at 100kV. Nominal maximum electric power: 80 kW</p> <p>Radiography Radiographic tube voltage setting range: 40 kV to 150 kV, in 1-kV increments Radiographic tube current setting range: 25 mA to 1000 mA Radiography time setting range: 1.0 ms or less Automatic Exposure Control (AEC): Anatomical Settings should be available Radiographic condition automatic setting: The radiographic conditions should be automatically set X-ray tube anode heat monitoring: Fluoroscopic tube current setting range: 0.5 mA to 4.0 mA in 0.1-mA increments Automatic Brightness Control (ABC) function Pulsed rate setting range variable up to 15 frame/s</p> <p>X-Ray Tube: Focal Spot (mm): 0.6/1.0/1.2 or less Anode Heat Storage Capacity of 600KHU or more.</p>
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	<p>X-Ray beam limiting device: X-ray exposure field size 43x43 cm Built-in light field lamp. FLAT PANEL DETECTOR: -- CSI or better with size 43x43 cm Effective number of pixels: 2840 pixels × 2840 pixels (vertical × horizontal) Pixel size: 148um or better. DQE: 60% or better. Spatial resolution: 3.4 lp/mm or more DIGITAL IMAGING SYSTEM: Basic image processor performance Images from the detector should be input in digital format. Image storage Capacity of hard disk: 50,000 images for 1024 × 1024 or 1TB HDD Storage Media (4.7GB) 2-Image display Monitors a) System monitor display for Playback images, processed images, multi- images, etc. b) Monochrome Medical grade Live monitor 1280 × 1024 pixels (SXGA) for Digital fluoroscopic images, fluorography images, playback images one in room with Original Trolley & One on Main Console Monitor etc. Fluoroscopic function Image processing • Recursive filter • Last image hold • Image flipping • Spatial filter (edge enhancement, smoothing) • Digital Compensation Filters. Recording Fluoroscopic image and last-image-hold image can be stored to hard disk. Fluoroscopic image acquisition • Frame rate variable up to 15 fps Fluorography function Images should be recorded to hard disk processed, and displayed on the monitor. Real-time image processing: Digital Compensation Filter and Super Noise Reduction Filter. Post processing Gray scale: Adjustment of contrast and brightness Filming Two Tray Laser imager with multi-sizes Printing of 14 x 17 and 8 x 10. Provision of DICOM 3.0 facility Power Requirements Line voltage: Three-phase, 200-440VAC Line frequency: 50 Hz Permissible line voltage fluctuation rate (no load): ±10% Online sine wave Double Conversion 160KVA UPS for digital radiography system, with a minimum backup time of 10 minutes on full load.(Imported)</p>
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12.	<p>DIGITAL RADIOGRAPHY SYSTEM Digital radiographic x-ray system radiography Recumbent, standing or seated patient position Ceiling - mounted x-ray tube assembly and digital imaging system. Motorized multileaf collimator</p>
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Fix Dual flat panel detector for table and chest stand separately
Automatic image positioning through vertical motorization of wall stand

X-Ray Generator

- 80 KW or better high-frequency X-ray generator
- 800 mA at 100 KV and 1 mAs to 800 mAs.
- 1 ms shortest exposure time.
- Integrated automatic exposure control (three chamber).
- Organ programs to be available.

Motorized Multileaf Collimator

- Ceiling-mounted tube assembly support, with tube assembly Multileaf collimator for vertical, oblique, horizontal, and lateral acquisitions
Rotation upto +/-40o or more. Filters to avoid soft radiation
- Automatic collimation and cassette and detector sensing. Manual collimation should also be available.

Patient Table

- Height adjustable patient positioning table with six way floating tabletop,
- Access the patient from all sides.
- Head to toe cassette and detector cover range.
- Autotracking during table height adjustment.
- Foot paddle for height adjustment of the patient positioning table of the floating tabletop.

Flat Panel Detector (cable less)

- Flat panel detector with active image size of 16"x16" or better
- Cesium (CsI) scintillator or better
- Pixel size 148 µm or better.
- Spatial Resolution 3.4 lp/mm or better or DQE 60% or more
- Matrix size approximately 2800 x 2800 or better.
- 14 bits or better detector depth.
- Time for data acquisition, transmission and viewing for full image to be 10 sec. or less.

X-Ray Tube

- Exposure voltage 140 kV or more.
- Focal spot 0.6 mm and 1.2 mm or better.
- Anode heat storage 600 KHU or more
- Motorized tube movement for precise imaging.

Chest Stand

- Motorized Chest stands with height-adjustable and tiltable Bucky cabinet to house FD and X-Ray cassettes /Detector holder for image acquisition.
- Chest stand should have moving exchangeable grid for scattered radiation reduction for Pediatric acquisitions.
The grid should be removable
- The chest stand should have servo / auto tracking i.e., the ceiling stand should move automatically with the height adjustment of the chest stand.

	<ul style="list-style-type: none"> - Complete with overhead handle for optimum positioning of patient for lateral exposures and lateral patient handles for optimum patient positioning, e.g. during PA thorax exposures. <p>Imaging System</p> <ul style="list-style-type: none"> - High resolution digital imaging reconstruction. Image display with DICOM network connection, complete with 19 inch color TFT display. <p>Digital Radiography System</p> <ul style="list-style-type: none"> - Dual core or better microprocessor with at least 2 GB Ram. - Storage of 5,000 or more images. - Imaging System should be capable of patient and study Administration <p>Administration</p> <ul style="list-style-type: none"> - Exposure and post processing <ul style="list-style-type: none"> - Image documentation, archiving, display of image markers. - Organ program selection and configuration. - Image processing functions such as rotate, mirror, zoom, window, filter, insert comment line and stich etc. - The system to have SW/HW to attain higher detail contrast (soft tissue and bone) - Reduced noise with the multi-scale procedures for images post-processing. - DICOM Functions include: Send, print and CD Write. - UPS for the digital system 5 KVA for 20 minutes backup. <p>Accessories</p> <ul style="list-style-type: none"> - Lead glass size 1.5 mm or better: size 80 cm x 100 cm. - Compression belt. - Lead Aprons 0.5 mm - Thyroid shield: 0.5 mm pb - Lead goggle and gonadal shields <ul style="list-style-type: none"> <input type="checkbox"/> DICOM 3.0 compliant Grayscale Dry LASER Printer with 3 online sizes. <input type="checkbox"/> Should have minimum productivity of 150 films/ hour in mixed sizes. <input type="checkbox"/> Printer should be capable of printing 08x10, 10x12, 11x14, 14x14 & 14x17 size films. <input type="checkbox"/> Minimum resolution should be 10 pixels/mm with 12-bit gradation. <input type="checkbox"/> 1000 x14x17" Dry LASER films <p>Optional: UPS 100KVA for 10 minutes backup of the whole system.</p>
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13.	<p>COMPUTERIZED RADIOGRAPHY SYSTEM</p> <p>One Digitizer / Reader unit, multiple plates type System for General Radiography & Mammography.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Should be capable to read X-Ray exposed Rigid Imaging Plates (IPs) of all standard sizes in inches/cm. <input type="checkbox"/> The productivity of reading / digitizing should be minimum 100 IPs/hour in mixed sizes. <input type="checkbox"/> Reading function should be 100 µm and 50 µm <input type="checkbox"/> Should support resolution of 10 pixels / mm. <input type="checkbox"/> One CR console for Radiographer with medical application software licenses.
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	<ul style="list-style-type: none"> <input type="checkbox"/> An additional workstation for Radiologist with 1TB HDD. <input type="checkbox"/> Should be capable to enter & edit Patient ID. <input type="checkbox"/> Should support Image Preview & Quality Assurance. <input type="checkbox"/> Should have Mammography Software License. (I.O to specify) <input type="checkbox"/> Should have temporary storage capacity of up to 2,000 or more images. <input type="checkbox"/> Should comply with DICOM Conformance 3.0 and have standard functions for future connectivity with PACS or other DICOM modalities inclusive of Print, Storage, etc. <input type="checkbox"/> DICOM 3.0 compliant Grayscale Dry LASER Printer with 3 online sizes. <input type="checkbox"/> Should have minimum productivity of 150 films/ hour in mixed sizes. <input type="checkbox"/> Printer should be capable of printing 08x10, 10x12, 11x14, 14x14 & 14x17 size films. <input type="checkbox"/> Minimum resolution should be 10 pixels/mm with 12-bit gradation. <input type="checkbox"/> Rigid Imaging Plates (IP) and Cassettes <input type="checkbox"/> 14x17inch (Set of IPs & Cassettes (I.O to specify) <input type="checkbox"/> 10x12inch (Set of IPs & Cassettes) (I.O to specify) <input type="checkbox"/> 08x10inch (Set of IPs & Cassettes) (I.O to specify) <input type="checkbox"/> 18x24cm (Set of IPs & Cassettes) for Mammography (I.O to specify) <input type="checkbox"/> 24x30cm (Set of IPs & Cassettes) for Mammography (I.O to specify) <input type="checkbox"/> 15x 30 cm (Set of IPs & Cassettes) for OPG (I.O to specify) <input type="checkbox"/> DICOM 3.0 for Send, Receive, Archive, Retrieve and Print. <p>POWER REQUIREMENT:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Single phase with line voltage of 220V, 50 Hz <p>Country of origin: USA/Europe/Japan</p>
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14.	<p>PRINTING SYSTEM FOR DIGITAL X-RAY</p> <ul style="list-style-type: none"> <input type="checkbox"/> DICOM 3.0 compliant Grayscale Dry LASER Printer with 3 online sizes. <input type="checkbox"/> Should have minimum productivity of 150 films/ hour in mixed sizes. <input type="checkbox"/> Printer should be capable of printing 08x10, 10x12, 11x14, 14x14 & 14x17 size films. <input type="checkbox"/> Minimum resolution should be 10 pixels/mm with 12-bit gradation. <p>Online UPS 10 KVA with ten minutes back up time.</p>
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15.	<p>STATIC X-RAY MACHINE</p> <p>Microprocessor based. High frequency, 50KW X-Ray generator. 500 mA at 100 kv Anatomical programmed radiography. Digital display of all set parameters. Rotating anode x-ray tube, with dual focus 0.6 & 1.2/1.5 mm. Anode heat storage capacity of at least 300 KHU or more Electronic timer with exposure time of 1msec. System with AEC facility. Ceiling mounted with three directional movement Capable of lateral radiography. 6-way floating table Chest stands with Bucky.</p>
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	<p>Complete with grid 8:1 ratio. Automatic over-load protection device and automatic line compensation. 3-phase, 380 V, 50 Hz.</p>
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16.	<p>MOBILE X-RAY UNIT Mobile Microprocessor based X-Ray Unit. High frequency, 30KW X-Ray Generator. 300 mA at 100 kv Digital display of all set parameters. Rotating anode x-ray tube, with dual focus / Single Focus Anode heat storage capacity of at least 107 KHU or more Electronic timer with exposure time of 1-3 msec. Automatic over-load protection device and automatic line compensation. The unit should be battery supported for exposure 220 V, 50 Hz.</p>
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17.	<p>MOBILE C-ARM IMAGE INTENSIFIER C-arm x-ray unit mobile for radiography and fluoroscopy High frequency, power output of 2.2 kw or more. 40 to 110kv with one shot fluoroscopy facility of 6ma or more. X-ray tube with stationary anode or better Dual focal spots of 0.6 and 1.5 mm Automatic Fluoro dose control Collimator : remote control of collimator, iris and blades diaphragms motorized with x-ray grid TV camera : high sensitivity, CCD camera, 1024 x 1024 pixels with last image hold Display : two 48cm (19") LCD/TFT monitors, medical quality on separate Mobile Trolley Digital video memory 10000 images or more Noise reduction filter, last image hold, pulsed fluoroscopy Edge enhancement, image inversion to be provided Real time digital image rotation Fluoroscopy footswitch: one cassette holder 24x30cm Laser localizer lights cross beam type</p>
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18.	<p>DOSIMETER</p> <ul style="list-style-type: none"> • Loud Alarm, 85 Db (A) Typical, (> 90 Db (C) Peak) • Vibrating Alarm • Highly Visible Backlit Display • Simple 2-Button Navigation • Extended Dose Rate Alarms • Dual Ultra Bright Led Alarm • Superior X-Ray And Gamma Energy Response • Meets Or Exceeds Applicable IEC And ANSI Standards • Designed For Ruggedness And Durability • Display Dose: 1 μ Sv To 10 Sv • Display Rate: 10 μ Sv/H To 10 Sv/H
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19.	CASSETTES (8x10 / 10x12 / 12x15 / 14x17)
20.	HANGERS (8x10 / 10x12 / 12x15 / 14x17)
21.	INTENSIFYING SCREEN DIFFERENT SIZES Intensifying screen of Luminescence technology Easy to clean protective layer Set of all standard sizes.
22.	HANGERS AND INTENSIFYING SCREEN (8x10 / 10x12 / 12x15 / 14x17)
23.	LEAD APRONS: Lead aprons with hangers all 0.5 mm Pb equivalent(Front)
24.	X- RAYS VIEWER, LED Ultra Thin X-Ray Film illuminator using LED Lamps, wall mounted. For two/Three/Four Films (<i>Procuring agency will specify the requirement</i>) Thickness: 30 mm or less. Viewing area: 370x420mm. +/- 05 % variation is acceptable LED Lamps life: More than 30000-40,000 hours. Easy insertion & removal of the film X-Ray film Holder: Rust-free steel clapper (rolling pin) Homogeneous illumination, flicker free. Illuminance:3500-4500 cd/m ² . On-Off button & separate Brightness control. Film sensor to turn-off at some interval after film removal. 220V, 50Hz
25.	X-RAY FILM PROCESSOR: High throughput free Standing type Continuous roller transport Sheet film, 10x10cm-35x43cm sizes (14"x17") High through put more than 110 sheets (35 x 43cm) Forced hot air circulation method Piping installed in the DEV and FIX racks. Processing solution temperature; Controlled by the temperature control tank, with the thermistor monitoring, with the heater heating and with the wash water cooling. Drying temperature; Controlled automatically according to a fixed temperature setting.

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