MRI 3T Machine

The manufacturer/bidder must quote the latest 3 Tesla MR System or better as per the specifications below.		
The offered model should be the latest model in that segment		
The offered model should be USFDA/ European CE with notified bodynumber or BIS approved (authentic and legible certificate for the same to be submitted)		
Also, the vendor will guarantee that the system supplied is not refurbished/older machine and the MR system quoted is the latest best available model in the segment (3T MR scanner with 70 cm or more bore) quoted, at the time of delivery and should submit an undertaking in this regard.		
S.No.	**Features**	**Essential Specification**
1	**Magnet**	3 Tesla (superconducting) Magnet with approximately 70 cm or more bore diameter. It should have facilities of better illumination ventilation & flared opening. System design should avoid patient claustrophobia. Silent MRI for neuro protocols including T1W, T2W imaging without any loss of image quality on all sequences (like Neuro Silent/ Silenz, or equivalent), with noise less than 80 dB. The quiet scanning should be without loss of SNR.
	a)Field Strength	Helium only 3 T (superconducting) Magnet along with Magnet Power supply Facility for quick shutdown of the magnet in case of emergency.
	b) Field Stability over time	i) Should have active shielding, external interference shielding with good field stability. Field stability overtime should be < or equal to 0.2 ppm/hr.
		(ii) Mention the RF frequency of operation and the field drift.
	c) Homogeneity	(i) Best homogeneity possible should be given. Specify homogeneity in VRMS at 10 cm, 20 cm, 30 cm and 40 cm DSV and at max. FOV achievable with the quoted scanner.
		(ii) Should be very good for Single voxel and CSI spectroscopy. Specify values.
		(iii) Please specify the homogeneity at 40 cm FOV (guaranteed homogeneity).
		(iv)Please specify up to what FOV gradient linearity is maintained.
		(v) Automatic shimming in phantom should be better than 0.55ppm in 40 DSV.
	d) Magnet Bore	(i) 70 cm or more magnet bore diameter, after positioning of gradient, shim and RF coils with flare.
		(ii)Physiological signal, coil connections and table adjustments display should be on the gantry of the magnet
	e) Active Shielding/ Fringe field	(i) Magnet should be shielded from external interferences. Smaller fringe field preferred 5 Gauss and 10 Gauss Line in X, Y, Z axis specify yours Quote value for 5 gauss and 10 gauss line. The 5 Gauss line will have to be marked.
	f) Ext. Shielding	(i) Ext. interference shield (sufficient to house the Magnet, Anaesthesia and physiologic monitors) should be provided.
	g) Magnet Cooling System	(i) The magnet should be having zero boil off rate. Cryogen vessel to be of Helium only with appropriate super thermal shielding and refrigeration facility for zero Helium boil-off, Specify the Helium tank capacity and boil-off rate.

		(ii) Devices for helium level monitoring in the magnet should be supplied.
		(iii)Emergency helium release button should be provided at least In two places [inside MR examination room and console room
		(iv) Liquid helium should be supplied during warranty period and CMC.
		(v) The vendor should include the Cold Head maintenance and replacement during warranty period and also during CMC
	h) Shim System	(i) High performance and highly stable shim system with global and localized manual and auto-shimming for high homogeneity magnetic field required for imaging (MRI/fMRI), single voxel spectroscopy (MRS), and spectroscopic imaging (MRSI). 3D shimming for volume imaging and CSI.
		(ii) Auto shim (global and voxel shim) should take minimum time to shim the magnet with patient in position (specify the time).
		(iii)System should have higher order/ 2nd order shimming as standard
		(iv)Off-centre shimming should be possible.
2	**Gradient System**	(i)Activity shielded Gradient System in X,Y,Z planes with strength of at least 80 mT/m
		(ii)Slew rate of system should be at least 200 T/m/sec
		(iii)Actively shielded (AS) whole body gradient system with strength minimum of 80 mT/m with slew rate of 200T/m/sec for each axis simultaneously.
		(iv)The Gradient system should have provision for eddy current compensation. Mention level of Eddy current compensation in %
		(v)Field of View should be at least 50 cm in all three axes.
		(vi)Minimum TE & TR in 2D/3D should be specified in relation to the sequences.
		(vii)Minimum Slice Thickness in 2D & 3D should be specified in 'relation to the sequences.
		(viii)Echo Train length in both 'spin echo and Gradient echo should be at least 255 or more.
		(ix)The measurement matrix should be from 128x128 to 1024x1024 in both 2D and 3D imaging as well.
		(x) Effective cooling system for gradient coil and power supply, for uninterrupted operation during summers also.

3	**RF Transmitter, Receiver, Coils**	
	a) RF Transmitter	A fully digital RF system capable of transmitting power of at least 30 KW with a single or combination of RF power amplifiers to reduce magnetic susceptibility effects for better B0 homogeneity. Specify transmitter frequency range. (i) A fully digital RF system capable of transmitting enough power (please quote the value) (as per FDA guidelines), and the operating frequency should cover 1H
		(ii) Specify max. transmitter RF power available (at 50Ω Impedance).
	b) RF Receiver	(i) Optical/ Digital RF receiver system with/ high efficient RF receiver system / or its equivalent located on the magnet inside the shielded scan room.
		(ii) Minimum 64 independent RF receiver channels or channel independent with each having bandwidth of 1MHz or more along with necessary hardware to support quadrature/CP array coils. System should have capability of activating 64 channels in a single FOV.
		Please provide the list of coils/coil-combinations that use this configuration.
		(iii) Specify the RF receiver bandwidth for each channel.
		(iv) The system should have necessary hardware to support quadrature phased array and flex coils.
		(v)It should support Parallel acquisition techniques like ASSET/SENSE/iPAT with a factor of at least 4.
	c) SAR limits	(i) SAR limits should be as per FDA guidelines for all protocols, including neuro/ abdominal imaging.
	d) Coils (in addition to the in- built body coil)	(i) The number of channels and number of elements for each coil should be the maximum that the vendor has in their product list. All coils (other than coils for exclusive spectroscopy, like surface coils) should be compatible for parallel acquisition. However, it is the responsibility of the *OEM* to provide necessary interface (both hardware and software) to make the coil work with appropriate RF sequences, etc. Please mention the true acceleration factor for each of the array coils.
		(ii) Head coil (64-independent channel or more) for EPI/ DTI applications. Compatible with fMRI projection device quoted with the system.
		(iii) Head Neck Coil of **20**-channel or more for neurovascular applications. If separate neck coil can work in combination with head coil, then the neck coilis to be included at no extra cost, and the vendor should make sure NV application is satisfied. All coils should have independent minimum channels as specified and should not be combined.

		(iv) Spine Coil offering atleast 12 channel imaging in single FOV with built in sensor.
		Body phased array coil with 46 channels or more (single or in combination) in 50 cm in Z-axis coveragefor imaging of abdomen. Light weight coils with less than 1.8Kg to be offered as standard. Second body coil (46 channel) to be provided.
		Dedicated Breast coil 16 channel or more.
		Dedicated RIGID Shoulder coil at least 16 channel or more should be offered
		Dedicated RIGID Wrist coil at least 16 channel or more should be offered or It can be deleted, if opted for 16 Channel Flex Coils as stated under
		Dedicated RIGID Knee coil at least 16 channel or more should be offered
		Suitable coil should be offered for PA studies. This should at least cover 80cm with at least 28 elements. Multiple coils should be offered to avoid coil repositioning.
		(xi) Flex coils in available sizes (minimum 2) for extremity imaging or Loop flex coils (large and small) - 16 channels or more for imaging of large regions such as large shoulder, hip and knee & small regions such as small to medium shoulder, wrist, elbow and ankle. (xii)Suitable coil for cardiac imaging / second body coil (at least 30 channel) (xiii)Endorectal coil for prostate (xv)Eye/ear coil
		(xvi)Vendor shall offer user friendly 4 or more coil acquisition in order to optimize the throughput-increase and increased effective FOV. The coil system shall cover a body length of at least 200cm. This 200cm should be possible with surface coil.
	e)Coil Technology	(i) Latest Integrated coil technology as available with the vendor to be quoted: Equivalent of TIM / GEM / D Stream or equivalent to be offered.
		(ii)The supplier should quote coils or their combinations exclusively for each application. The number of coils should be as per the BOQ. It should be mentioned as independent coils and not having overlapping applications.
	f) Table Technology	(i) Bolus chasing with automatic/continuous moving table should be offered and should be available with fluoro triggered MR angiography for manual and fast switchover in less than 1 sec for CEMRA.
		(ii) Latest table technology available with the vendor (globally) should be offered.
4	**a) Patient Table**	(i) Computer controlled subject table movement in vertical and horizontal direction. Position accuracy should be +/- 1.0 mm or better.
		(ii) The vendor should supply fully motorized computer controlled table, with movements in vertical and horizontal directions for the main MRI patient table.

		(iii) Subject table should be able to take at least 200 Kg load.
		(iv) Emergency manual traction of the subject from the magnet.
	b) Patient monitoring	(i) Patient monitoring devices for ECG, respiratory, pulse rate, oxygen saturation, at the console etc. A comprehensive solution at patient side and at main console capable of gating the sequence protocols with respect to patient's heart (ECG) and respiratory rates.
	c) Patient Comfort Features	(i) Two-way Patient communication with headphone, microphone and necessary accessories.
		(ii) Patient audio alarm and hand held alarm system
		(iii) Lighting
		(iv) Music system (complete)
	d**) User's care, Cleaning, Disinfection & Sterility issues**	Disinfection: Parts of the Device that are designed to come into contact with the patient or the operator should either be capable of easy disinfection or be protected by a single use/disposable cover. Sterilization not required
		(vii) Close Circuit TV and CCD video camera for patient monitoring.
		(viii) Provide other standard patient comfort devices, with quoted system (please specify)
5	**Computer Control System/ Operator Console**	(i) The vendor should supply the latest computer system along with the MR system, to handle all the latest applications available on the MR platform.
	a) Host Computer and Array Processors	(i) Latest computer system with sufficient RAM (**32** GB or more) and computational speed to match the single shot Echo Planar Imaging (EPI), interactive angiogram, multi-planar three dimensional (3D) reconstruction, surface rendering and dynamic imaging, vascular imaging/angiography, and adequate storage for images and other applications.
		(ii) Necessary image processor with sufficiently large RAM.
		(iii) (32 GB or more) for ultra-fast image reconstruction, capable of performing real-time image reconstruction.
		(iv) Total hard disk memory capable of storing a minimum of 4 TB or more to be sufficient to store at least 250,000 images of 256 x 256 matrix data size. Systems offering higher storage will be preferred. The system should have CD/DVD archiving facility on the main console and work station
		(v) Monitor 24" or more TFT monitor with enhanced graphics accelerator.
		(vi) One measurement (Main) console capable of data acquisition and all online calculations and Post processing.

		(vii)There should be a provision of retrieval of the reconstruction data (raw files) in user friendly manner.
		(viii)DICOM interface to hook DICOM dry/laser camera capable of storing printing 1024 x 1024 matrix size images at least in 16 format without loss of digital resolution.
		(ix)The system should be capable to connect to PACS through RIS/HIS at no extra cost. Highest version of DICOM connectivity to be provided.
		(x)Zero Foot Print Application - Application viewing images on Tablet & Mobile which is FDA approved from the same OEM who is providing the Modality.
		(xi) Licenses for acquisition, post-processing and for special packages should be given explicitly listing all the capabilities of the vendor's quoted product (basic standard package, premium packages, etc).
		(xii) The main console/workstation should have pulse sequence software license that may be required to modify and run pulse sequences. If this is not possible, the vendor should provide the necessary hard and software necessary for such application (like laptop with system interface solution). Appropriate procedures (like research agreement) should be finalized before the installation of the equipment, so that there is no delay in operation of any requirement.
	b) Additional Workstation	**Workstation**
		A workstation from the Manufacturer with preferably the same user interface as of main console is required with the availability of all necessary software including basic post- processing software including MIP, MPR, surface reconstruction and volume rendering technique.
		Advanced post-processing offered application including perfusion quantification advanced diffusion and DTI, including perfusion analysis, processing of 2D/3D CSI data, with color metabolite mapping.
		3 numbers Workstations with 3 concurrent licences for all basic applications and all should be concurrently capable of advanced applications, Post Processing, 2D, MIP. MPR, Filming, CD/DVD Burning/ USB Flash Drive) The Workstation should be capable of doing the followings, 2D flat image view • 3D volumetric reconstruction • Multi-planar reconstruction view • Export a model to a graphic file or to the new series of DICOM images • Print images on paper and film using a DICOM

		printer • Burning data to CDs, DVDs, and flash drives. With Core i7 processor or better, 32 GB RAM or more , 4TB hard drive, DVD Writing with high resolution monitor of minimum 2 MP resolution, keyboard& mouse with 1000 compatible DVDs.
		Two external storage SSD of at least 5 TB to be provided for storage of cases. Three desktop PC (i7 with 8GB RAM , 1TB HDD,21" monitor, keyboard mouse and UPS) to be provided for reporting purposes. Three high quality black and white laser printer to be provided for reporting purposes The workstation should enable printing in laser film camera and color printers.
	c) Networking	(i) The vendor should provide Level 3 network Switch (with 32 nodes) or latest, to integrate the network,
		(ii) Protocol - Ethernet TCP/IP standards - based image transfer with DICOM 3.0 over standard Ethernet IEEE 903 (DICOM send, receive and DICOM query modes).
		(iii)The vendor should provide the connectivity with PACS, with the user department.
		(iv)The network speed and cables should match the latest industry standards (eg.10BaseT/100BaseT/1 GB).

		(v) System should be configured with different IP series, so as not to clash with different equipment already existing in different departments.
		(vi)The vendor should provide necessary networking and configuration assistance with existing PACS, HIS, RIS.
	d)Film documentation	DICOM interface to hook DICOM compatible, dockable, latest state of art Dry Laser Camera with resolution of 16 bits/500 dpi or more capable of storing/printing images of 1024 x 1024 (or higher, if available) matrix size in various matrix formats (including 16 format) without loss of digital resolution to be made available on any of the consoles and on the films (Agfa/Fuji/Kodak etc), with three online tray system. The system must have at least three online film sizes, and should be capable to print on any of the 8 X10, 10 x 12, 14 x 17 sizes. The system should be freely configurable by the user, to use any of the above mentioned size. should be supplied with 500 films of each size.
	e) Printer	Colour Laser Network Printer (PCL6/PS) for printing of colour CSI/Perfusion/BOLD maps and images and film documentation on paper (minimum 24 ppm).
6	**a)Data Acquisition**	(i) The system should be capable of 2D and 3D acquisitions in conventional, fast & ultra-fast spin echo and gradient echo modes so that real-time online images can be observed if needed. All the sequences that are available with the vendor at the time of quote/delivery should be provided as per their manual.
		(ii) Up to 1024 x 1024 matrix acquisitions preferred for all applications. Wherever 2048 matrix available,please mention. Minimum 512 x 512 matrix acquisition for all applications.
		(iii)Half Fourier or other techniques to reduce scan acquisition time while maintaining adequate SNR.
		(iv)3D volume, multiple contiguous slabs, multiple interleaved and multiple overlapping slabs.
		(v) Slice thickness in 2D and partition in 3D to be freely selectable.
		(vi)Dynamic acquisition (serial imaging) with capability to initiate scan sequences either from the magnet panel or from the console.
		(vii) Dynamic acquisition: number of repeat scans with delay time either identical time interval or selectable.
		(viii) Auto-slice positioning from the localizer images.
		(ix)Maximum-off center positioning both anterior-posterior and lateral direction and should be selectable.
		(x) Gating: physiological signals like ECG, pulse, respiratory, External signal 2D multi-slice imaging should be possible in all planes (axial, sagittal, coronal, oblique and double oblique)
		(xi) Triggering (interface for triggering input pulse from external source). The provision should be available at the console also (for fMRI, EEG, etc).

		(xii) Simultaneous acquisition, processing and display of image data in 2D multi-slice mode.
		(xiii) Selection of voxels from oblique slices should be possible while doing spectroscopy.
		(xiv) Artefact reduction/imaging enhancement/image filtering/image subtraction/addition/multiplication/ division techniques

		(xv) Flow: 1st and 2nd order flow artefact compensation.
		(xvi) Presentation slabs: a number of relocatable saturation bands to be placed either inside or outside the region of interest.
		(xvii) Graphic prescription.
		(xviii) Fat saturation techniques: frequency selective RF pulses to suppress fat signals in the measured image FOV. ROI selective (regional) fat suppression should also be given.
		(xix) Magnetization transfer saturation: Off resonance RF pulses to suppress signals from stationary tissue in FOV.
		(xx) Phase contrast capability in 2D and 3D mode.
		(xxi) Image intensity correction.
		(xxii) Breath hold acquisition.
		(xxiii) EPI mode
		(xxiv) DTI with MDDW or equivalent with a minimum of 12 and selectable up to 128 direction encoding.
		(xxv) Data acquisition in all three standard planes (axial, sagittal, coronal) and oblique and double oblique planes or more oblique planes.
		(xxvi) Higher matrix acquisition capability in single shot EPI. Acquisition time, TR, TE and slice thicknessshould be clearly mentioned and supported by data sheet reference.
		(xxxi) The vendor should offer multi coil acquisition in order to optimize throughput increase and increased effective FOV. Individual acquisition elements of every coil should be mentioned. Additional requirements: ***Cardiac Package – T1, T2*** ***MR- elastography – T1, T2 mapping*** ***Sequence of MR imaging of joints with metal implants.*** ***Ortho O_RXD should be offered.*** ***Post contract K-radial filling sequences.***
	(i) Imaging Pulse sequences	(i) The system should be capable of selecting TR and TEs as per requirement in majority of the pulse sequences.
		(ii) Spin echo (SE): multi-slice single echo, multislice multi-echo (8 echo or more) with minimum TR and TE, SE with symmetrical and asymmetrical echo intervals : fast spin echo. MT-SE imaging sequence.
		(iii)Inversion recovery (IR): including short TI modified IRSE, FLAIR, DIR (Double Inversion Recovery) MT and FLAIR

		(iv) Gradient echo (GE): with transverse gradient/RF spoiling, and transverse gradient re-phasing, e.g., GRASE or equivalent etc. 3D gradient echo with shortest TR and TE, free choice of flip angle selection, while maintaining SNR.
	(ii)Fast sequences	(i) Fast spin echo and GE sequences in 2D and 3D mode with T1, T2 and PD contrast capable of acquiring maximum number of slices with a given TR a minimum TE, echo train should be at least 128 or more in fast spin echo mode.
		(ii) Half Fourier acquisition capabilities should be available with/without diffusion gradients and in combination with fast spin echo.
		(iii) Fast inversion recovery with spin echo.
		(iv) Fast gradient spin echo IR multi-slice multi- echo mode with maximum Turbo factor. Sequences should incorporate RF focusing to acquire ultra-fast gradient spin echo.
		(v) Fast gradient echo sequence should incorporate RF spoiling and other technique to acquire images in ultra-fast 2D and 3D modes.
		(vi) Fat and water suppressed imaging sequences.
		(vii) EPI optimized sequences (with and without fat suppression)
		(viii) For T1, T2, PD imaging, perfusion, regular diffusion values (at least 5b, 3 directions) EPI-FLAIR, EPI-IR, EPI-FLAIR diffusion tensor, EPI-MT-FLAIR, tensor diffusion (at least 16 b values, and 128 directions) and diffusion studies. Suitable artefact/ fat suppression techniques to be incorporated in the sequence to have optimum image quality.
		(ix) There should be capability of calculating ADC map (isotropic and anisotropy from the regular diffusion and tensor data).
		(x) Optimized sequences for special applications.
		(xi) Multi-band EPI: Simultaneous Multi Slice Accelerate advance applications for clinical routine.
		(xii) Sequence optimisation using compressed sensing technique should be available in neuro, body, cardiac &MSK imaging
	(iii) Optimized Sequence Packages	Mention all available packages
	b) Neuro	(i) All T1 (2D, 3D), T2 (2D, 3D), IR (2D, 3D), Dual IR (2D, 3D) sequences.
		(ii) Sequence for internal ear imaging for visualization of fine structures like cranial nerves (appropriate sequences like CISS, etc or equivalent). Mention the sequences provided.
		(iii) 3D sequences like CUBE, SPACE, VISTA for internal ear imaging.
		(iv) Dynamic imaging of pituitary using appropriate sequence.
		(v) Whole spine T1, T2, IR sequences.

		(vi) Whole neuro examination with automatic planning, scanning and post-processing, with single localiser positioning, without changing the coils/ repositioning.
		vii) MR ventriculography, cisternography, myelography.
		(viii) Flow quantification packages for CSF with dynamic CSF.
		a. flow imaging, aqueduct and spinal canal.
		b. Sequence with ultra short TE.
		c. Sequence for nullifying CSF pulsation artifacts.
		d. Sequence enabling prospective motion correction in quick time and in real time during fMRI.
		e. Sequence employing arterial spin labelling (ASL) technique.
		f. Whole body imaging (using body coil and surface coils)
		g. Automated fusion and composing for the above two (without any artefacts)
		h. Volume acquisitions for neuro applications.
	c) Angiography	(i) MR angiography: 2D/3D TOF, 2D/3D Phase contrast (with and without gating) and magnetizationtransfer saturation, black blood angiography for cerebral, pulmonary, abdominal and peripheral vessels.
		(ii) For peripheral moving table angiography should be offered covering hip to limbs to be examined in one go with high resolution and high SNR.
		(iii) Bolus tracking software package.
		(iv) Sequences for breath hold angiography with contrast enhancement.
		(v) Sequences for time resolved angiography with contrast kinetics.
		(vi) ECG triggered non-contrast angiography.
		(vii) Contrast bolus tracking (including single shot whole body MRA, interactive and automatic tracking, etc.).
		(viii) Perfusion study in organ systems like kidney, brain, heart etc. with T1 perfusion with permeability maps, and quantitation of rCBF/ rCBV, MTT, etc, with colour maps with required licenses.
		(ix) NON-Contrast Angiography techniques like Native, lnhance, Trance for whole body applications to be quoted as standard
	d)Cardiac package	(i) Full comprehensive cardiac sequences which includes, MR cardiology package for evaluation of heart in long and short axis with black blood cardiac imaging.
		(ii) Package for coronary artery imaging including sequences for motion compensation - prospective and retrospective gating, etc.
		(iii) EPI based sequence for stress perfusion MRI including ability to adjust the cardiac phases required with increasing HR.
		(iv) Myocardial tagging sequence.
		(v) 2D and 3D Sequences enabled with delayed enhancement.

		(vi) 3D sequence of cine (bright blood & dark blood options)
		(vii) Rapid acquisition of heart using acceleration techniques.
		(viii) STIR sequence for cardiac use.
		(ix) 3D whole heart sequence (with & without contrast for coronary imaging)
		(x) Ability to acquire multiple arterial ad venous phases on CE MRA.
		(xi) Quantitative flow analysis software.
		(xii) 3D acquisition of whole heart in one breath-hold.
		(xiii) 4D TRAK/ TRICKS-XV/ TWIST/ equivalent (with maximum FOV).
		(xiv) Pulmonary 2D/3D MRA sequence, including single breath hold sequence, timing drug infusion
	e) Diffusion /DTI	(i) Sequence package for diffusion including DTI (tractography) study in organs like brain and spine,
		(ii) There should be capability of calculating ADC map (isotropic and anisotropic from the regular diffusion and tensor data).
		(iii) MR diffusion tensor imaging package with tractography.
		(iv) MR neuro functional imaging sequence package (incl. Mosaic, etc)
	f) Body imaging	(i) Flow quantification in vessels and hepatobiliary system.
		(ii) Fly-through facility with Flow analysis including display of various velocity values.
		(iii) Optimized breath hold sequences for abdominal Studies including angiogram.
		(iv) MR Cholangiography and Pancreatography: Specialized sequences and processing to perform MRCP.
		(v) Single sequence to acquire four different contrast (inphase, out-of-phase water only, fat only). The same technique should be used in other sequences, for dynamic angiography/ T1 quantitative analyses.
		(vi) Parallel acquisition techniques such as SENSE/SMASH/ASSET/GRAPPA, IPAI, ARC and other new sequences to be quoted as standard. Specify the technique used and the factor by which the acquisition time is reduced for similar acquisition with and without parallel imaging technique. Mention the sequences.
		(vii) Radial/Spiral pulse sequences for ultrafast imaging.
		(viii) Suitable artefact/fat suppression techniques to be incorporated in all the sequences to have optimum image quality.
		(ix) A sequence for differentiation of fluid and cartilage in ortho applications (sequence like DESS or equivalent)
		(x) Susceptibility artefact correction techniques to be incorporated in all the sequences to have optimum image quality. Sequences for MRI imaging of joints with Metal Implants like advanced WARP/ SEMAC/ o_MAR XD should be offered.

	g) SWI	(i) Sequences for susceptibility imaging.
	h) Prostate imaging	(i) Sequences for imaging of prostate.
	i) Breast imaging	(i) Sequences for imaging of breast (including sagittal bilateral breast imaging in a single acquisition)
	j) Whole Body Diffusion	DWIBS OR equivalent
	k) m- Dixon	(i) Provide sequences like m- Dixon for all applicable sequences, m Dixon- HD or equivalent.
	l) Relaxometry	T1 mapping and T2 mapping with necessary post-processing s/w.
	m) Motion correction	(i) Sequence for in-line motion correction for uncooperative patients/ children (with software and acquisition - sequences like BLADE, PROPELLAR, Multivane or equivalent)
	n) MR Spectroscopy	(i) System should have capability to perform multi- planar proton and phosphorous spectroscopy (31P).
		(ii) Proton MRS Sequence for single-voxel acquisition, with selectable fat/lipid saturation bands, options of water saturation (eg. VAPOR, CHESS, etc) with all post-processing software.
		(iii) Proton Multi-voxel CSI [2-D and 3-D] acquisition and metabolite mapping with all necessary RF sequences (and post-processing algorithms) with all post-processing software.
		(iv) If separate coils are needed for carrying out MRS, it should be provided.
		(v) RF sequences for cardiac, prostate, breast, liver, Musculoskeletal and brain (if there are any specialised/optimised sequence available, the same should be offered)- with all post-processing software.
		(vi) Water and lipid suppression in automated sequences.
		(vii) The pulse sequences for 31P MRS and 1H MRS for liver, cardiac spectroscopy, etc. should have external gating provision with triggering bases on ECG/ Respiratory, with all post-processing software.
7	**Post Processing and evaluation**	(i) Licences of all the post processing and evaluation packages should be provided for the main and additional console/workstation.
		(ii) Specify clearly number wise the algorithms that need licenses and a statement whether these have been provided in both the main console and the additional workstation (satellite console/ extended workspace).
	a) Special Application Packages	(i) The vendor must provide their specialized and optimized imaging sequences in the Main Acquisition Console; Post processing packages in the Main Acquisition Console and all additional workstation.
		a) Neuro (Smart exam/Ready Suite/ Smart Brain/etc.)
		b) Body
		c) Oncology
		d) Cardiac

		e) Angio (including DSA approach, capturing arterial, capillary and venous phases in a single acquisition with a single bolus),
		f) Ortho and MSK,
		g) Liver (including 3D T1-Fatsat for dynamic liver imaging)
		h) Pediatric
		i) Breast
		j) Prostate
		K) Necessary composing s/w for whole spine and whole
		body applications. Smart Brain / Ready Suite / Brain Dot Engine / equivalent technique should be quoted for Brain Imaging.
	b) MPR	(i) Multi-planar reconstruction (MPR) in any arbitrary plane including curved planes with freely selectable slice thickness and slice increments.
		(ii) Surface Reconstruction and evaluation on reconstructed images with minimum time.
		(iii) MIP in displaying in cine mode 2D and 3D mode, targeted/segmented MIP in any orthogonal axis with minimum processing time and capable of displaying incine mode.
	c) Cardiac evaluation package	Cardiac evaluation: Operator selective or automatic contour mapping and calculation of cardiac parameters like wall thickness, stroke volume, Ejection Fraction, filling rate, myocardial wall motion includingdisplay of data in table, graph and in cine mode, blood flow quantitation, velocity mapping, pressure gradient quantitation, shunt quantitation, regurgitation calculation, stenosis, blood flow, etc. These should be usable on main as well as on additional workstation/ satellite console.
	d)ADC, perfusion, etc	(i) Evaluation and display of diffusion images, ADCmap, fMRI in reference of EPI optimized sequence.
		(ii) Perfusion image evaluation with time intensity graph and other statistical parameters.
		(iii) Evaluation package for calculating rCBV, rCBF, MTT, perfusion map, corrected CBV calculation; Fusion of perfusion map with Contrast enhanced 3D T1 images etc. Mention the package/software offered with brochure.
		(iv) Flow quantification and evaluation for vascular (high & low) CSF, bladder outlet and cine display.
	e) Arterial Spin Labelling	2D or 3D ASL processing and quantification package in main console/additional workstation
	Liver Segmentation	Automatic Liver segmentation and volumetric analysis.
	f) BOLD analysis	(i) Evaluation of functional images of brain with appropriate statistical algorithms, colour display and overlay on base anatomical images with required license.
		(ii) Software for evaluation of functional mapping [BOLD evaluation] and neuro-metabolite mapping.
	g) VBM	Voxel-based morphometry for segmentation and quantification.

	h)Tractography	Post-processing package for DTI and Tractography, estimation of ADC, FA (Lamda- parallel, perpendicular separately and combined), Fiber tracking, fiber statistics, and display of fiber tracks on anatomical image(s).
	i)Image statistics	(i) Measurement of distance, area, volume, angle, mean, SD, image addition, subtraction, mulltiplication,division interpolation, segmentation, threshold, histogram.
		(ii) Image filtering and Image fusion software.
		(iii) Software for co-registering MRI/ fMRI/ MRS/ Metabolite mapping images with images from CT, PET, and SPECT.
		(iv) Evaluation features like zoom, rotation, scroll, roaming, image synthesis, multi point T1 and T2 calculation (more than 8) window stretching, text dialogues graphics, sorting, searching, archiving, recalling etc.
	j) Spectroscopy	(i) Full post-processing for single-voxel MRS, CSI (multi-voxel MRS), metabolite mapping with colour coding (metabolic images) etc., for brain, breast, prostate and for other applications.
		(ii) Post processing should include FFT, base line correction, curve optimization, automatic phase correction, metabolite imaging, spectral mapping, magnetic resonance spectroscopic imaging (molecular imaging) with naming and peak integral values for all in-vivo metabolites.
	k) Advanced organ specific imaging	Advanced organ specific imaging with automatic planning, scanning and post-processing application should be quoted as fat and iron quantification of liver and heart.
	l)Advanced Technology	Latest Technologies: Technology to automatically detect breathing triggered scans like BioMatrix patterns as soon as the patient lies on the table for simplified workflow and minimize user interaction for respiratory sensor or Vital eye to be offered. Vendors with latest technology shall be preferred.
	m) Silent MRI	Silent MRI for neuro protocols including T1W, T2W imaging without any loss of image quality on all sequences (like Neuro Silent/ Silenz, or equivalent), with noise less than 80 dB. The quiet scanning should be without loss of SNR.
8	**Functional MRI accessories and post-processing**	(i) Functional Imaging with package for BOLD imaging and processing package (capable of real-time processing and display of colour overlay (in real time) using 32-channel Head coil being supplied with the system.
		(ii) Complete fMRI solution including audio-visual projection (3D capable) system, with headphones withvery good noise suppression (>30dB) (Preferable to have LCD/LED monitor for projection).
		(iii) The system should be integrated with stimulus presentation/ paradigm generator software, along with permanent license (like Superlab, eprime, Presentation, etc), for task presentation to the subject.

		(iv) The paradigm presentation should be synchronised with the scanner (for starting along with measurements)
9	**Quality assurance and Phantoms**	(i) Phantoms for routine quality assurance for all coils (including body coil)
		(ii) Quality assurance as per AAMP standard for SNR for different coils and nuclei, spatial resolution, magnetic field inhomogeneity, eddy current compensation, RF power and inhomogeneity measurement. Specify the details of the QA package. Itshould be possible to provide the QA report quarterly to the Faculty-in-charge, MRI for records.
10	**Standard MRI Accessories**	(i) Rechargeable Hand held metal detectors (2 Nos.)
		(ii) Walk through Metal detector with multiple sensor and multiple location LED (Zone III type) - 01 no.
		(iii) MR compatible (minimum 5000 Gauss line) cardiac and physiological monitor (ECG, NIBP, SPO2,) for neonates/ infants and adults (with all accessories for five years) (Invivo/ Iradimed/ equivalent models)
		(iv) MR Compatible Dual Pressure injector MRI Compatible with dual head injector with Syringe size as 65 and 115 ml Quantity: 100 syringes and tubings prices needs to be supplied.
		(v) Facility to incorporate various FR calculators and KVO.
		(vi) Facility to ARM and INJECT from Injector head.
		(vii) Upgrade Facility to interface with contrast dose management software.
		(viii) Unit price of syringe and tubings to be quoted separately for additional requirement.
		(x) Two quantity: Non-magnetic IV stand.
		(xi) Two quantity: Digital Patient Weighing Scale (in the range between 0 to 200 kg)
		(xii) MR compatible storage carts and wall mounted cabinets.
		(xiii) Coil cabinets to be provided.
		(xiv) Network cable and other required materials for the complete installation to be provided by the supplier.
		(xv) MR compatible crash-cart - 1 No.
		(xvi) MR compatible instrument-trolley - 1 No.
		(xvii) MR compatible patient trolley (to transfer patientto the magnet table) with both vertical and horizontal movement with hydraulic operation and should take a minimum load of 150 Kg in both vertical and horizontal motion (Adjustable Height Trolley) - 2 No.
		(xviii) MR compatible wheel chair foldable (with cushion, back-rest and armrest) - 2 No.
		(xix) MR Compatible Cart for biopsy handling, etc - 1 No. **(xx) Transport Ventilator** **(xxi) Anesthesia Work Station**

11	**Antivirus s/w and Web updates**	(i) All the Servers and Workstations in the network MRI console, additional workstation, PACS workstation, fMRI workstation, etc) that is supplied by the vendor should be provided with antivirus software (periodically updated) for whole life time.
		(ii) The vendor should provide antivirus updates for whole life time and make sure of the updated antivirus every week (using automatic updates with internet facility by the vendor)
		(iii)The vendor should ensure that all the above modalities include necessary connection, image & work list send/receive, image & data storage, scheduling, patient registration, and synchronization functions as per DICOM standards for smooth and effectiveintegration to RIS/PACS.
12	**Other accessories**	(i) Table for the MRI console, MRI additional console/ workstation, fMRI workstation.
		(ii)Necessary Desk, chair and Rack for the PACS Server& Workstation to be provided by the supplier.
		(iii)All the necessary interconnecting interfaces, cables, modules and other hardware and software to fully integrate the system for full operational status
		(iv)Uninterrupted power supply (UPS) with sufficient capacity (appropriate rating as required with a minimum of 160 kVA or more UPS) for 30 minutes back up of the full load MR system and its accessories during patient MR imaging.
		(v)Two (quantity) MR compatible oxygen cylinders with flow meter and stand (for the anaesthesia system).
		(vi) MR compatible laryngoscope – one adult and one pediatric.
		(vii)Good quality air curtain at MRI entrance (for patient entry), to filter the dust and prevent the leakage of a/c.
		Advanced training to be provided by the vendor at the site for Faculty, Residents, students and Radiographers, so as to benefit the latest applications available on the system. The training should beminimum period of 12 weeks, staggered.
13	**Experience Criteria**	Bidder should have proven track record in Central/State government/PSU and should have at least 3 installations of the same system during the last three years with satisfactory performance report from the HOD of the User department of Institution. Also company and model name of the unit offered should be clearly mentioned.

14	**Training**	Advanced training to be provided by the vendor at the site for Faculty, Residents, students and Radiographers, so as to benefit the latest applications available on the system. The training should beminimum period of 12 weeks, staggered.
15	**Scope of Turnkey**	i. The MRI unit is to be installed on turnkey basis ii. Turnkey would include dismantling and disposal of redundant fixtures and execution of all necessary civil, electrical, plumbing and air conditioning work at site iii. The layout plan and other site requirements are to be finalized in consultation with head of Department of Radiology along with PMD/Engineering department of the concerned site. iv. Work related to anesthesia workstation and layout of gas pipelines as required by the anesthesia department to be done in consultation with Head of department of Anesthesia. v. The supplier shall be required to undertake all the pre-installation, site preparation work in the area as per the layout plan. vi. The bidder will inspect the site for feasibility before tendering and submit the layout plan for approval by the HOD. vii. The MRI complex will comprise of various rooms like MRI Examination room, console room, reporting room, changing room, electrical equipment and UPS room and any other required room for MRI facility. The site work will be as per approved plan. viii. During construction, modifications can be permitted by the user department of the hospital for more efficient utilization of space and resources. ix. All items to be used should he of very good quality and are to be used only after the approval is granted by the department or other relevant hospital authorities. In case the same is not done, the vendor shall have to dismantle the existing

		material and Carry out fresh work at his own cost. x. Rates of the following components of turnkey project should be quoted with system. I. Civil II. Electrical III. Public health (water supply) and fittings),if any IV. Furniture and other items V. Miscellaneous
16	**Installation on Site - Modification basis**	(i) The system should be installed and handed over in working condition, with all the necessary electrical, air-conditioning and civil works undertaken by the vendor in consultation with the user department. Some re-arrangement of the existing place including relocation of staff place may have to be carried out.
		(ii) All the necessary interconnecting interfaces, cables, modules and other hardware and software to fully integrate the system for full operational status.
		(iii) Installation and integration of the uninterrupted power supply (UPS).
		(iv) The Site-Modification items, UPS, Generator and other local items have to be quoted in Indian rupeesonly.
		(v) Water/ Air chiller should be of good quality, with performance guaranteed during summer months also.
17	**Civil works**	Fire alarm (along with new/existing panel) should be provided in all rooms, wherever site modification is being carried out, and in the rooms (in the MRI section), where there is no fire alarm. The vendor should discuss with the engineering section and the department before quoting for Site-Modification.
18	**Air-conditioning works**	(i) Air-conditioning that is required for the MRI equipment, examination room, and Console areas have to be carried out.
		(ii) Necessary adequate air-conditioning units. The vendor should discuss with the engineering sectionand the department before quoting for Site-Modification.
		(iii) The installation of the MR system should becomplete with all accessories.
19	**Special Conditions**	Please see below mentioned special conditions, including Warranty and CMC.

20	**Hardware Upgrade**	The MR system should be regularly maintained in the latest version of computing software, including software platform upgrades released for the respective system that can prepare it for future enhancements. If a HW upgrade is required to run the latest software version to its normal performance, the respective HW should be upgraded at no additional costs during the complete life of the system.
		The MR computing software system should offer built-in security controls to protect the system from vulnerabilities that can result in cyberattacks or inappropriate access to patient data. The built-in security should comply with the latest international standards of data security and encryption, as well as with existing regulations to protect personal and protected health information (e.g., GDPR, HIPAA, any local regulation), during the complete life of the system.
21	**Standard and Safety**	Should have import/manufacturing license from Central licensing Authority or State licensing authority of CDSCO for Medical Devices and copy of valid license should be submitted for the quoted model. In case the vendor has not yet obtained import/manufacturing license from CDSCO for the quoted model, proof of application for CDSCO medical device license to be submitted in the bid document and valid CDSCO license to be produced at the time of supply/ NOA for the quoted model
22	Original Product Datasheet of main unit and all accessories, including all items to be provided. All agreementsshould be binding on Principal. The principals should be responsible for any lacuna or deficit in service or supply.	
23	All items in the supply order should be supplied during the time of installation. No exceptions will be allowed.	
24	Items under Agreement should be finalized well in advance (after receipt of supply order), so that there is no delay in delivery of software or coil or any other accessories.	
25	Software upgrades/ updates (where hardware upgrades are not required) like new pulse sequence, new application package, etc, should be provided within one month after release worldwide (any country, viz. North America / Europe / Germany, etc). In case, the same is not provided in time, the parent company should undertake the responsibility to implement the same. This is to make sure that the machine stays updated with similar products for full life span of the equipment.	
26	**WARRANTY PERIOD**	
	The warranty period of the 3T MRI system commences from the date of handing over (from the date of issue of Inspection Note) the fully functional unit of all coils and the accessories supplied (such as UPS including batteries replacement as when required, AC, etc.) to the Institute, against manufacturing defects of material and workmanship. The Helium Supply and cold head repairs (including replacement, if needed) should be included in the warranty period.	

27	**POST GUARANTEE ANNUAL COMPREHENSIVE MAINTENANCE CONTRACT (CMC):**
	The post- warranty (after **5** years) CMC should be comprehensive and should include helium and cold head (repair and / or replacement) + labour + spares for the complete system which includes all the accessories supplied such as UPS, AC, etc. (including all consumables like batteries for UPS, and maintenance for another **5** years. This CAMC should be quoted in Indian rupees.
	Note: Any Liquid Helium filling due to quenching or due to any other causes during the CMC period shall be borne by the firm.
	If a particular coil is not working for more than 5 days and due to which patient work suffers, the firm will be asked to pay penalty of half-a-day beyond 5 days for each day that it is not working.
28	**Buy Back:** Buyback option where applicable may be duly evaluated
29	**DOCUMENTATION** 1. Should provide 2 sets(hard copy and soft copy) of: 2. User, technical and maintenance manuals should be supplied in english/Hindi language along with machine diagrams; 3. List of equipment and procedures required for local calibration and routine maintenance; 4. Service and operation manuals(original and Copy) to be provided; 5. Advanced maintenance tasks documentation; 6. Certificate of calibration and inspection, 7. Satisfactory certificate for any existing installation from government hospital
30	**SERVICE SUPPORT CONTACT DETAILS (HIERARCHY WISE; INCLUDING A TOLL FREE/LANDLINE NUMBER)** Contact details of manufacturer, supplier and local service agent to be provided; Any Contract(AMC/CMC/ad-hoc) to be declared by the manufacturer.
31	**RECOMMENDATIONS OR WARNINGS:-** Any warning sign would be adequately displayed

ENVIRONMENTAL SPECIFICATIONS

a) Temperature and Relative humidity ranges to be maintained as per prescribed standards.
b) Air conditioning load: the heat load calculations and maintaining the desired temperature and humidity in toto shall be the responsibility of the bidder.