Notice Inviting e-Tender

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SUPPLY & INSTALLATION OF 3 TESLA MRI MACHINE IN THE MEDICAL COLLEGE AND HOSPITAL OF GOVERNMENT OF WEST BENGAL.

(Submission of Bid through *online*)

Bid Reference No.: WBMSCL /NIT-232/2020	Dated –25.11.2020

Amendment-I

A. Technical Specification

Technical Specification for 3 Tesla-Magnetic Resonance Imaging (MRI) Machine

TECHNICAL SPECIFICATION

The manufacturer / bidder must quote a latest model (no software upgrade on the already launched model will be accepted as latest model), launched in 2016 or after of 'State of the Art' 3 Tesla MR System or better as per the specifications below:

- Please mention that year of launch of the quoted model
- The offered model should be USFDA approved (authentic and legible certificate for the same to be annexed)
- Also, the vendor will guarantee that the system supplied is not refurbished 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.

Sl. No.	Features	Essential Specification
1.	Magnet	3 Tesla (superconducting) Magnet with approximately 70 cm or more bore diameter.
	a) Field	Helium only 3T (superconducting) Magnet along with Facility for

	Strength	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. 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)
	d) Magnet Bore	i) 70 cm or more magnets bore diameter , after positioning of gradient , shim and RF cons
	e) Active Shielding / Fringe field	i) Quote values for 5 Gauss and 1 Gauss line.
	f) Ext. Shielding	Ext. Interference shield (sufficient to house the Magnet, Anesthesia and Physiologic monitors should be provided)
	g) Magnet Cooling System	i) The magnet should be having zero boil off rate ii) Devices for helium level monitoring in the magnet should be supplied. iii) Liquid helium should be supplied during warranty period and comprehensive AMC iv) The vendor should include the Cold Head maintenance and replacement during warranty period and also during Comprehensive AMC
	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) Magnetic homogeneity should be <0.5 at 40 cm DSV iii) Auto shim (global and voxel shim) should take minimum time to shim the magnet with patient in position (specify the time). iv) Specify number of shim coils including higher order.
2.	a) Patient Table	i) Computer controlled subject table movement in vertical and horizontal direction. ii) The vendor should supply fully motorized computer controlled table, with movements in vertical and horizontal directions for the main MRT patient table. iii) Subject table should be able to take at least 140 kg load. iv) Emergency manual Traction of the subject from the magnet.
	b) Patient	i) Should supply MRI Compatible (US FDA and CE Certified)

	monitoring	Patient monitoring devices (at least 15 inches) for ECG, respiratory (RR), NIBP, IBP, pulse rate, oxygen saturation, $ETCO_2$ at the Gantry room. Should have parallel display of parameters at Console room. Monitor specifications as per annexure II. ii) Should also have Gantry side display of Patient Demography, Coil information and basic vital signs .
	c) Patient Comfort Features	i) Two-way patient communication with headphone, microphone and necessary accessories.
		ii) Patient audio alarm
		iii) Lighting
		iv) MR compatible Music System (complete) should be able to play inside the gantry
		v) One MR compatible patient trolley (to transfer patient to the magnet table)
		vi) One MR compatible wheel chair
		v) Closed circuit TV and CCD video camera for patient monitoring
		vi) Provide other standard patient comfort devices, with quoted system (please specify)
3.	Gradient system a) General	i) Active shielded gradient system in X, Y , Z planes
		ii) Minimum Gradient Strength should be 44 mT/m or more along each axis and a slew rate of 200 T/m/s in each axis. Minimum rise time from 0 to 44 mT/m should be 220 µs. The system should have 64 independent RF receiver channels (which can be demonstrated)
		iii) In case of dual gradient systems, please mention the details in each axis separately.
		iv) Quote the minimum rise time at the maximum gradient strength offered.
		v) Quote the slew rate at the maximum gradient strength.
		vi) Specify the linearity of the gradients at full FOV.
		vii) 100% duty cycle for full FOV
		Viii) All other tender specifications remaining the same, if the vendor has a 3T MRI of higher gradient available , then quote that as an option
	b) Resolution Parameters	i) Specify the minimum and maximum FOV achievable for the quoted MR system (preferable to have 10-450 mm FOV)
		ii) Specify min. slice thickness in 2D and 3D modes at 128 x 128, 256 x 256, 512 x 512 and 1024 x 1024 matrices.
		iii) The system should be capable of performing single shot EP1 (in 64 x 64 , 128 x 128 and 256 x 256 matrixes) including Conventional and fluoroscopic imaging in the three orthogonal and also oblique planes

		iv) Effective cooling system for gradient coil and power supply for uninterrupted operation during summers also. The system should have efficient and adequate provision for eddy current compensation
4.	RF Transmitter, Receiver , Coils	The vendor should quote the latest RF transmit technology available with them globally, as per the datasheet.
	a) RF Transmitter	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 1 H, and 31P nuclei (for multinuclear spectroscopy of 1H/31P)
		ii) Specify max. transmitter RF power available (at 50 ohm 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 active room.
		ii) System should have 64 independent RF receiver channels (which can be demonstrated). 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.
	c) RF Transmit Technology	v) Latest RF transmit system (like Multi-transmit / Multi Drive transmit system / True form) with at least two independent output channels should be offered to improve B1 uniformity and signal homogeneity and to reduce patient induced in-homogeneities.

	d) SAR limits	i) SAR limits should be as per FDA guidelines for all protocols , including neuro / abdominal imaging
	e) Coils	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. In case the vendor does not have or manufacture a particular coil, third party coil(s) can be provided. However, it is the responsibility of the vendor to provide necessary interface (both hardware and software) to make the coil work with appropriate RF sequences etc
		ii) Head coil (48-channel or more) / 64 Channel Head Neck , for high resolution brain, brachial plexus, nerve imaging, EPI/DTI applications, compatible with fMRI projection device quoted with the system. The coil should have built in shim arrangement for high

		resolution.
		iii) Separate coil for Head neck at least 16 channels or more for routine brain / Neurovascular exams should also be quoted as standard. A inbuilt shim system in head coil for improved imaging would be preferred
		iv) Spine array coil (32 channel or more)
		v) Body array coil / Phased Array coil(32 Channel); If a single coil is not available with the vendor, then a combination of coils should be quoted (capable of single station abdominal imaging), so that the resolution over 50 cm FOV is not compromised.
		vi) Dedicated shoulder array coil (16 channels), if a dedicated coil is not available with the Vendor, then the vendor has to quote equivalent coil (for e.g. if Flex coil is offered, then the number should be in addition to the previously quoted coil.
		vii) Dedicated Wrist Coil (16 channel)
		viii) Dedicated Knee imaging Transmit / Receive 15 channel or more)
		ix) Dedicated Peripheral coil or whole body coil with a coverage of at least 80cms (with a maximum combination of 2 coils)
		x) Eye / Ear coil
		xi) Flex coils in available sizes (minimum 2) for extremity imaging at least 4 channel or more.
		xii) Dedicated foot / ankle coil, minimum 8 channels or more xiii) Dedicated breast coil for imaging, spectroscopy and biopsy (7 channel or more)
	f) Coil Technology	i) Integrated coil technology, latest as available with the vendor to be quoted : Equivalent of TIM / GEM / DStream or equivalent to be offered.
	g) 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 CE-MRA.
		ii) Latest table technology available with the vendor (globally) should be offered.
5.	Computer Control System	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.
		ii) During the warranty period, any software updates that are launched globally should be supplied and installed; The

			Company should bear the cost of the hardware changes, if required for the software update.
	(a) Host Computer and Array Processors	i)	Latest state-of-art computer system with sufficient RAM (32 GB or more) and computational speed to match the single shot Echo Planar Imaging (EP1) , 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)	(4 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 2,00,000 (two lakh) images.
		v)	Monitor 19" or more Medical grade monitor.
		vi)	One measurement (Main) console capable of data acquisition and all online calculations) and post processing
		vii)	Licences 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.)
		viii)	The main console / workstation should have pulse sequences software license that may be required to modify and run pulse sequences. If this is not possible, the vendor should provided the necessary hard and soft ware 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		SERVER SYSTEM : (A Client – Server Architecture based solution, minimum 20,000 concurrent slices, 2 no. floating / concurrent user license for all applications. DICOM 3.0 compatibility and interfacing with other modalities must be possible.
			CONFIGURATION : 1 no. Server and 2 nos. Clients / Nodes. 1 user license for each of the applications to be provided as standard.
			Licences :2 no Concurrent license here implies the capability to process all the loaded software to be accessible and usable on all the clients / nodes simultaneously without any processing delay. The software should also include a reputed antivirus software of a perpetual type or renewed by the supplier.

		Hardware: **Client / Node**: CPU unit, minimum 32 GB RAM, Medical grade monitor of 3 MP resolution and size – 21″ or more, mouse, keyboard.
		Hardware Server: The server (single / dual configuration) should have image storage capacity of at least 2.5 Tera bytes, minimum 20,000 concurrent slice processing power and at least 64 GB RAM, 19″ or more TFT / LCD monitor.
	(c) CD/DVD archival	i) DVD RW drive for writing of images , spectra and raw data along with the necessary software for reading the images and spectra on DVD/CD storing capabilities.
		ii) Provision for archival of **k space data and raw (unprocessed) Images**.
	(d) 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 D1COM 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 Departments, as mentioned in Item No. 10 of this tender.
		iv) The network speed and cables should match the latest industry standards (eg. 10 BaseT/100 BaseT/1GB)
		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 and RIS.
	(e) Film Documentation	DICOM interface to hook DICOM compatible, dockable, latest state of art Dry Laser Camera with more than 500 dpi, 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 with three online tray system.
6.	a) Data Acquisition	i) The system should be capable of 2D and 3D acquisitions in conventional, fast and ultra fast spin echo and gradient echo modes so that real-time online images ran lie 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) 2D multi slice imaging should be possible in all planes (axial, sagittal, coronal, oblique and double oblique).
		iii) Up to 1024 x 1024 matrix acquisitions preferred for all

		applications. Wherever 2048 matrix available, please mention.
		iv) Half Fourier or other techniques to reduce scan acquisition lime while maintaining adequate SNR.
		v) 3D volume, multiple contiguous slabs, multiple interleaved and multiple overlapping slabs.
		vi) Slice thickness in 2D and partition in 3D to be freely selectable.
		vii) Dynamic acquisition (serial imaging) with capability to initiate scan sequences either from the magnet panel or from the console.
		viii) Dynamic acquisition; number of repeat scans with delay time either identical time interval or selectable.
		ix) Auto slice positioning from the localizer images.
		x) Maximum off center positioning both anterior posterior and lateral direction and should be selectable.
		xi) Gating: Physiological signals like ECG, pulse, respiratory', External signal triggering (interface form 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) Artifact reduction /imaging enhancement / image filtering/ image subtraction/addition/multiplication/ division techniques.
		xv) Flow: 1st and 2^{nd} order flow artifact 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 tie 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) Breathe hold acquisition.
		xxiii) EPI mode
		xxiv) DTI with MDDW or equivalent with a minimum of 128 directions encoding.
		xxv) Data acquisition in all three standard planes (axial,

		sagittal, coronal) and oblique and double oblique planes and more oblique planes.
		xxvi) Higher matrix acquisition capability in single shot EPI. Acquisition time. TR , TE and slice thickness should be clearly mentioned and supported by data sheet reference.
		xxvii) 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.
	b) Imaging Pulse Sequences	(i) All standard and special pulse sequences available at the time of quote / delivery should be offered and quoted in the bid
		(ii) The System should be capable of selecting TR and TEs as per requirement in majority of the pulse sequences.
		(iii) Spin echo (SE): multi-slice single echo, multi-slice multiecho (8 echo or more), SE with symmetrical and asymmetrical echo intervals and fast spin echo. MT-SE imaging sequence.
		(iv) Inversion Recovery (IR): including short TI modified IRSE, FLAIR, DIR (Double Inversion Recovery)
		(v) 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.
	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 ETL. 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. EP1-IR. EPI-

		FLAIR diffusion tensor, EPI MT FLAIR, tensor diffusion (at least 16b values and 128 directions) and diffusions studies. Suitable artifact / 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.
	Optimized sequence Packages	Mention all available packages
	c) 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 C1SS, etc. or equivalent. Mention the sequences provided.)
		iii) 3D sequences for internal auditory canal 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 localizer positioning, without changing the coils / repositioning.
		vii) SMS : Simultaneous Multi Slice Imaging
		viii) 2D or 3D ASL.
	d) Cardiac	Advanced Cardiac Packages with coronary artery imaging (3D Cardiac imaging, 3D whole heart, Iron quantification, vascular mapping, Myocardial perfusion, pressure gradient mapping, velocity measurement/ differential velocity measurement, tagging, free breathing, ejection fraction etc.).
	e) Angiography	i) MR angiography : 2D / 3D TOF , 2D/3D Phase contrast (with and without gating) and magnetization transfer 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 etc. with T1 perfusion with permeability maps and quantitation of rCBF / rCBV, MTT etc. with colour maps
	f) Diffusion / DTI	i) Sequence package for diffusion including DTI (tractography) study in organs like brain , kidney , muscle , heart , spine , breast etc.
		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.)
		v) Application for high resolution diffusion imaging to be provided.
	g) Body Imaging	i) Flow quantification in vessels and CSF ,hepatobiliary system.
		ii) Fly through facility with Flow analysis including display of various velocity value.
		iii) Optimized breath hold sequences for abdominal studies including angiogram.
		iv) MR Cholangiography and Pancreatography: Specialized sequences and processing to perform MRCP.
		v) Pulmonary 2D / 3D MRA sequence, including single breath hold sequence
		vi) MR ventriculography, cisternography, myelography
		vii) 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 portography / T1 quantitative analyses.
		viii) Parallel acquisition techniques including new sequences. 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.
		ix) Flow quantification packages for CSF with dynamic CSF flow imaging, aqueduct and spinal canal.
		x) Radial / Spiral pulse sequences for ultrafast imaging.
		xi) Suitable artifact / fat suppression techniques to be

		incorporated in all the sequences to have optimum image quality.
		xii) A sequence for differentiation of fluid and carriage in ortho applications (sequence like DESS or equivalent)
		xiii) Susceptibility artifact correction techniques to be incorporated in all the sequences to have optimum image quality.
	h) SWI	i) Sequences for susceptibility imaging
	i) Prostate Imaging	i) Sequences for imaging of prostate
	j) Whole Body Diffusion And STIR, Angiography	DWIBS OR equivalent, whole body imaging using Inversion recovery sequences, whole body MR angiography
	k) m-Dixon	i) Provide sequences like m-Dixon for all applicable sequences, m-Dixom-HD or equivalent.
	l) Relaxometry	T1 mapping 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
		ii) Sequence with ultra short TE
		iii) Sequence for nullifying CSK pulsation artifacts
		iv) Sequence enabling prospective motion correction in quick time and in real time during IMRI
		v) Sequence employing arterial spin labelling (ASL) technique
		vi) Whole body imaging (using body coil and surface coils)
		vii) Whole body diffusion weighted imaging (using body coil and surface coils)
		viii) Automated fusion and composing for the above two (without any artifacts)
		ix) Volume acquisition for Neuro applications
	n) MR Spectroscopy	i) System should have capability to perform multi planar proton
		ii) Proton MRS Sequences for single-vowel acquisition, with selectable fat / lipid saturation bands, options of water saturation (eg. VAPOR, CHRSS 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 prostate, liver, musculoskeletal and brain (if there are any specialized / optimized sequence available, the same should be offered) with all post processing software.
		vi) Water and lipid suppression in automated sequences
	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 licences and a statement whether theses have been provided in both the main console and the additional workstation (Satellite console / extended workspace)
	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 additional workstation.
		(a) Neuro (Samrt, exam / Ready Suite / Smart Brain/ etc.)
		(b) Body
		(c) Oncology
		(d) Angio (including DSA approach , capturing arterial, capillary and venous phases in a single acquisition with a single bolus)
		(e) Ortho and MSK, Metal artifact reduction software should be provided as standard for imaging of joints with prosthesis.
		(f) Liver (including 3D T1 Fat sat for dynamic liver imaging), Liver elastrography, Liver segmentation, Liver Iron & Fat quantification.
		(g) Pediatric
		(h) Breast
		(i) Prostate
		(j) Necessary composing software for whole body applications. Smart Exam / Samrt Brain / Ready Suite / Brain Dot Engine/ equivalent technique should be quoted in all available imaging packages.
	(i) 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 lime and capable of displaying in cine mode.
	(ii) ADC perfusion, etc.	i) Evaluation and display of diffusion images, ADC map, IMRI 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 far vascular (high & low) CSF, bladder outlet and cine display.
	Arterial Spin Labeling	2D or 3D ASL processing and quantification package in main console / additional workstation.
	Live Segmentation	Automatic Liver segmentation and volumetric analysis.
	(iii) BOLD analysis	i) Evaluation of functional images of brain with appropriate statistical algorithms, colour display and overlay on base anatomical images.
		ii) Software for evaluation of functional mapping [BOLD Evaluation and Neuro-metabolite mapping].
	(iv) Tractography	Post-processing package for DT1 and Tractography , estimation of ADC, FA(Lamda parallel, perpendicular separately and combined), Fiber tracking, fiber statistics and display of fiber tracts on anatomical images.
	(v) Image statistics	i) Measurement of distance, area, volume, angle, mean, SD, image addition, subtraction, multiplication, 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 SPCET.
		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, searchmfl. Archiving, recalling etc.
	(vi) Spectroscopy	(i) Full post-processing for single voxel MRS, CS1 (multi-voxel MRS), metabolite mapping with color coding (metabolic images) etc., for brain, prostate and for other application.*
		(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 matabolites.
	(vii) Advanced organ specific imaging	Any advanced organ specific imaging with automatic planning, scanning and post-processing application should be quoted.
	(viii) Silent MRI	Silent MRI for neuro protocols including T1W, T2W imaging without any loss of image quality on all sequences with noise less than 80 dB. The quiet scanning should be without loss of SNR.
	(ix) Advanced Compress Sensing Imaging	System should have the Advanced Compress Sensing Imaging.
	Functional MRI accessories	(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 Head coil being supplied with the system.
		(ii) Complete fMRI solution including audio visual projection (3D capable) system, with headphones with very good noise suppression (>30 dB) (Preferable to have LCD/LED monitor projection)
		(iii) The system should be integrated with stimulus presentation / parading generator software ,along with permanent license (like Superlab, Nordicaktiva,
		(iv) The paradigm presentation should be synchronized with the scanner (fur starling along with measurements).
	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 inhomogenecity, eddy current compensation, RF power and inhomogencity measurement. Specify the details of the QA package. It should be possible to provide the QA report quarterly to the Faculty-In-Charge, MRI for records.
	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 nos.
		(iii) MR compatible Infusion Pump (Annexure-2) (specifications are mentioned separately)
		(iv) MR Compatible Dual head Pressure Injector (minimum 2000 Gauss line)

		b) MR Compatible pressure Injector (with 200 syringes and 200 patient tubings).
		(v) Unit price of syringe and tubing to be quoted separately for additional requirement.
		(vi) MR compatible anesthesia machine (Specifications are mentioned separately : Annexure-3)
		(vii) 2(two) quantity : Non-magnetic IV stand
		(viii) 2(two) quantity : Digital Patient Weighing Scale (in the range between 0 to 200 kg)
		(ix) MR compatible storage carts and wall mounted cabinets
		(x) Coil cabinets to be provided
		(xi) Network cable and other required materials for the complete installation to be provided by the Supplier
		(xii) MR compatible crash cart - 1 no.
		(xiii) MR compatible instrument – trolley - 1 no.
		(xiv) MR compatible patient trolley (to transfer patient to 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 (Model: Adjustable Height Trolley : MR5501 of Wardray Premise Ltd., U.K. or Adjustable Height Trolley , Femo UK or equivalent) - 1 no.
		(xv) MR compatible wheel chair (Wardray / equivalent model) (with cushion , back-rest and anti-rest) – 1 no.
7.	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 5 (five) years
		(ii) The vendor should provide antivirus updates for 5(five) years 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, images and work list send / receive, image and data storage, scheduling , patient registration and synchronization functions as per DICOM standards for smooth and effective integration to RIS / PACS.
8.	Other accessories	(i) 10(ten) chairs with arm rest with medium back without casters (Godrej / Geeken Make)
		(ii) Table for the MRI console, MRI additional console / Workstation. fMRI workstation
		(iii) Necessary Desk, Chair and Rack for the PACS Server & Workstation to be provided by the supplier.

		(iv) All the necessary interconnecting interfaces, cables, modules and other hardware and software to fully integrate the system for full operational status.
		(v) Uninterrupted Power Supply (UPS) with sufficient capacity (appropriate rating as required with a minimum of 200 kVA or more UPS) for 30 minutes back up of the full load MR system and its accessories during patient MR imaging.
		(vi) 2(two) quantity MR compatible oxygen cylinders (for the anesthesia system)
		(vii) Good quality air curtain at MRI entrance (for patient entry), to filter the dust and prevent the leakage of a/c
9.	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 be minimum period of 12 weeks, staggered.
10.	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.
		(ii) All the necessary interconnecting interfaces, cables, modules and other hardware and software to fully integrate the system for full operational status.
		(iii) Accessories, air conditioning etc.
		(iv) Water / Air Chiller should be of good quality, with Performance guaranteed during summer months also.
	Civil works	(i) 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
	Air-conditioning works	(ii) Air-conditioning that is required for the MRI equipment, examination room and Console areas have to be carried out by the vendor with a new unit. Proper dueling and other necessary work have to be carried out without damaging existing structure.
		(iii) Necessary adequate air-conditioning units.
		(iv) The installation of the MR system should be complete with all accessories.
	Special conditions	Please see Annexure for special conditions, including warranty and CMC
	1.	a) Original Product Datasheet of main unit and all accessories,

		including third party items to be provided.
		b) All agreements should be binding on Principal. The principals should be responsible for any lacuna or deficit in service or supply.
	2.	All items in the supply order should be supplied during the time of installation. No exceptions will be allowed.
	3.	Items under Research Agreement should be finalized well in advance after receipt of supply order, so that there is no delay on delivery of software or coil or any other accessories.
	4.	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 Slavs updated with similar products for at least 5(five) years.
	WARRANTY PERIOD	
	5.	The warranty period of the 3T MRI system commences from the date of satisfactory installation & commissioning of the system. The fully functional unit of all coil and the accessories supplied (such as UPS including batteries replacement as when required, AC etc.) including third party items such as MR compatible infusion pump, patient monitor with probes, MR compatible anesthesia machine and Ferro guard to the Institutre, against Manufacturing defects of material and workmanship, if needed) should be included in the warranty period.
	6.	Note: any Liquid Helium filling, due to quenching or due to any other causes during the warranty period shall be borne by the firm.
	7.	If a particular coil is not working for more than 5(five) days and due to which patient work suffers, the firm will be asked to pay penalty of half-a-day beyond 5(five) days for each day that it is not working.
	POST GUARANTEE ANNUAL COMPREHENSIVE MAINTENANCE CONTRACT (CMC) :	
	8.	The post-warranty (after 2 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 (including all consumables like batteries for UPS, and maintenance for another 8 years. +including third party items such as MR compatible Infusion Pump, patient

		monitor with probes, MR compatible anesthesia machine against Manufacturing defects of material and works manship should be included in the CAMC period.
	9.	Note any Liquid Helium filling due to quenching or due to any other causes during the CMC period shall be borne by the firm.
	10.	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 is not working.
	11.	The actual drawing and planning can be worked by the vendors in consultation with their architects, the user Department and the Engineering section of **IPGME & R and WBMSCL**.
	12.	
	13.	The vendor must fill in the details (like values, Make and model etc.) so as to specify whether they satisfy the tender by handling each row of this compliance statement. The vendor should mark "**Yes or No or Not Available**" wherever applicable.
11.	SITE MODIFICATION WORK – 3T MRI SYSTEM	
1.	The Site Modification Scope of Work 3T MRI	
i.	The vendor should inspect the site at Woodburn Ward of IPGME & R and SSKM Hospital, before quoting and ensure that the unit can be installed in the available space without any functional.	
	Provisions should be made for placing the various accessories in console room, work-station and printer locations.	
	It should also include Door with glass peeping window, warning indicators and signage , false ceiling, GVT floor tiles and wall tiles / Paneling / painting	
	All site modification works should comply with specified standards of the hospital.	
ii.	While preparing the plan, the following aspects have to be addressed.	
iii.	Care should be taken to provide easy negotiation of the patient stretchers / trolleys through corridors and doors.	
iv.	RF shielding for doors, walls , glass viewer etc.	
v.	Furniture like desk chairs, shelves etc.	
vi.	Patient stretcher and other furniture / accessory to make the scan centre functional.	
vii.	The cost of Site Modification will be considered for Ranking / Evaluation purpose.	
viii.	Moreover Bidders will have to quote the Unit Rates of the following components of Site Modification work.	
(a)	Civil Works	
(b)	Electrical work	
(c)	Air Conditioning (HVAC)	
(d)	Fire Alarm at Detector	
(e)	Interior Furnishing and Furniture	
2.	Scope of work for Site Modification MRI unit works	

	The supplier should inspect the proposed site and submit all the detailed equipment layout drawings for the proposed MRI Scan Centre along with technical bid of the tender.
	The MRI SCAN CENTRE shall consist of the following rooms:
i)	MRI Room Gantry
ii)	Console Room
iii)	Electrical Room
iv)	UPS room / equipment room
v)	Patient preparation and changing room
3.	**Civil work:**
i.	Civil construction work including construction / demolition / alteration of brick wall, plastering, flooring as per the approved plan and equipment layout plan.
ii.	Concrete reinforcement required for MRI equipment area, if required
iii.	Platform for uploading and shifting the MRI should be provided if necessary.
iv.	Platform for Chiller unit if needed. Fencing and weather protection facility should be provided for the Chiller unit.
v.	Cable tray, trench and channel – necessary trenches, cable tray and channels at required location would be provided.
vi.	All the construction work to be done as per the final plan approved by the purchaser.
vii.	Active and passive room shielding for magnetic, fringe filed should be provided as per the requirement of the equipment.
4.	**Flooring**
i)	Hospital grade Vinyl Flooring of reputed brands (eg. Tarkett / Gerflor) for MRI Examination Gantry Room.
ii)	premier quality double charged (homogeneous) joint less vitrified mirror polished tiles 800mm X 800 mm / 600 x 600 mm vitrified tiles with 100 mm tile skirting to match in other rooms.
iii)	50 mm thick cement concrete flowing with 5 mm Vinyl flooring in MRI equipment / UPS room
iv)	Floor (except of MRI room) should be of premier quality double charged joint less vitrified mirror polished tiles.
5.	**Painting**
i.	2(two) coats Plastic Emulsion Paint over 2 coats of wall putty including primer in MRI equipment / UPS room and electrical room etc.
ii.	Pre laminated wall paneling in MRI examination –Gantry Room
6.	**False Ceiling**
i.	Lightweight Aluminum ceiling panels, acoustical-treated, supported n grid or finished seamless with support above ceiling. Powder coated finish (color to be approved by institute). The False ceiling inside RF cage as per equipment and RF cage requirement and design. Ceiling height to suit the equipment, mount and clearances.

ii.	**Wall (except MRI room):** Entire walls up to false ceiling should be of premier quality double charged (homogeneous) joint less vitrified mirror polished tiles
7.	**Electrical Work:**
i.	The supplier shall be required to specify the total load requirements for the MRI scan centre including the load of air conditioning, room lighting and for the accessories if any. The mains supply line will be provided by the Institute up to one point within the MRI scan centre area. The distribution panel shall be provided by the vendor. Few lights in each room shall be connected to the UPS to provide emergency backing.
ii.	**The electrical work shall include the following:**
iii.	Wiring – All interior electrical wiring as well as chiller and outdoor a/c units with main distribution panel board, necessary MCBs, DB, joint box, switch box etc. The wires shall be of copper of different capacity as per the load and should be renowned make as listed below. Electrical Earthing for all equipment and accessories supplied shall be provided by the vendor. The earth-pits should be located as per the approved by the Institute.
iv.	Switches light and power points should be of modular type and of standard make as listed below:-
v.	LED light fittings with minimum 500 Lux Illumination. 5″/6″ LED round light to be provided in MRI room to suit MRI functioning.
vi.	MRI compatible lights for MRI examination room. The lamps / bulbs used within the RF cage should be easy replaceable and locally available.
8.	**Air Conditioning** :
i.	Minimum 24 TR (12 TR working + 12 TR standby) with auto sequence controller. Online dehumidifier in MRI and Technical room.
ii.	Duct-able package air conditioners and split AC units may be used according to room requirement and suitability. Humidity control should be effective to eliminate moisture condensation on equipment surface. The Air Conditioning should be designed with standby provision to function 24 hours a day.
iii.	The outdoor units of AC should be located as approved by the Institute and should have full coverings to prevent theft and damage.
iv.	Copper pies and valve panel to be used for the Chiller to the MRI
v.	Environment specifications:
(a)	Humidity range: Relative humidity 60% and 80% in all areas except equipment room which shall be as per requirement of the equipment.
(b)	Temperature ranges: 22 ± 2^{o} C in all areas except equipment room which shall be as per requirement of the equipment.
(c)	Air conditioning load: The heat load calculations and maintaining tie desired temperature and humidity shall be the responsibility of the bidder.
(d)	MRI compatible Skylight [6 ft x 8 ft]
9.	**Furniture:**
i.	Chairs with arm rest with medium back without casters in the Control room,

	Radiologist room and viewing area. 10 nos.	
ii.	Cupboard with laminate door shutters for storage of spare parts and accessories and records as per requirement. - 3 NOS.	
iii.	MRI compatible drug trolleys for patient preparation area. - 1 NO.	
iv.	Name boards for all rooms.	
v.	Tables for Workstation and Radiologist in reporting room. 4 NOS.	
vi.	All furniture items should be of standard make as mentioned in the table below.	
10.	**Fire alarm & Detector** :	
i.	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.) Fire alarm shall comprise of fire panel, smoke / heat detectors. The vendor should discuss with the engineering section and the department before quoting for Site-Modification.	
ii.	Fire extinguisher Dry $C0_2$ type as required for the building safety. - One per room.	
11.	**Miscellaneous** :	
i.	Cabling of Network (LAN) connectivity far camera system, console system, workstation, servers arid computers etc.	
ii.	Cabling for Broadband connection: for REMOTE SERVICE of MRI system.	
iii.	MR compatible piping and oulets(4 lines} for Medical Air, Oxygen , Vacuum and N_20. To be provided in the Gantry room. The Hospital gas lines will be terminated outside the MRI area.	
iv.	Earthing: Three nos. of copper plate earthing.	
v.	Night vision CCTV camera with proper coverage of patient waiting area, entry gate, console & UPS room with storage capacity of 15 days	
vi.	PA system with FM / USB facility (Sony/Philips/Bosch)- 1 No.	
vii.	At least 15 -20 patient holding positions has to be mentioned in the drawing layout plan. Sufficient furniture to be supplied for the console room and patient waiting.	
viii.	Patient changing room with mirror	
ix.	Vaccum cleaner	
12.	**List of items and suggested manufacturers.**	
	ITEMS	PREFERRED MAKES
i.	Civil	
a.	Flooring Vitrified Tiles	Kajaria / H&R Johnson/ RAK india
b.	Paint	Burger / Dulux/ Asian Paints / Nerolac
ii.	ELECTRICAL	
a.	Cables (FRLS)	Finolex / Havells / V-Guard
b.	Switches	Legrand / L&T/ Crabtree / Roma
c.	Distribution Box	Legrand / L & T / Havells
d.	Light Fittings	Phillips / Havells / Wipro

e.	Air Conditioning (5 Star – with Green Gas)	Mitsubishi / Daikin/ Hitachi
iii.	**Furniture**	Hermen Miller/ Godrej/ Featherlite/ Wipro/Geeken

Annexure-1	
Specifications for MR Safe Dual Channel Syringe / Volumetric Pump (Infusion Pump)	
1.	The MR Safe pump should be adaptable both as a syringe pump as well as a volumetric pump.
2.	It should be designed for use in MR environment and not adopted for the purpose (should not be a non MR pump in an RF cage).
3.	It should have a non magnetic ultrasonic motor to provide accurate fluid delivery from infants to adults with capability of delivering two drugs simultaneously.
4.	It should come with a 10 digit keypad entry system for ease of programming.
5.	It should be 5000 Gauss compliant / 1.5 meter from isocentre compliance in MRI room, so that it can be placed anywhere in the MR room (up to 3 Tesla MRI.
6.	It should have a large LCD display providing high visibility.
7.	Expanded delivery range of the pump should be 0.1 – 1400 ml / hr.
8.	It should have a long life lithium polymer battery pack for more than 10 hours back up once fully charged.
9.	The syringe set should be self vented type with a very low priming volume.
10.	The system should be field upgradable to pulse oximeter monitoring.
11.	The downstream occlusion pressure should be adjustable from 1 – 10 psi to suit various cannula sizes and viscosity of the drug to be infused.
12.	There should be an air inline ultrasonic bubble detector.
13.	It should have a 3600 visible green / red bright flashing alarm light indication sufficiently big to be observed from control room itself in event of any alarm situation or for regular drug delivery confirmation.
14.	Optionally an MR Safe free standing IV pole & a wireless remote control which can control the pump in a seamless bidirectional manner using 2.4 GHz spectrum should also be quoted along with the main system.
15.	It should be CE marked and FDA approved.
16.	All the accessories including batteries should be provided for 10 years.
17.	It should be approved by major magnet manufacturer like Siemens / Philips / GE for use up to their 3T magnets.

Annexure-2	
Specifications for MR safe Portable Multi-Parameter Vital Sign Monitor	
1.	It should be a fully Non-Magnetic multi parameter portable patient monitoring solution, designed to be small, easy to use and lightweight.
2.	MRI vital sign monitor able to travel with the patient.
3.	It should be 5000 Gauss compliant / 1.5 meter from isocentre compliance in MRI room, so that it can be placed anywhere in the MR room (up to 3 Tesla MRI)
4.	The unit should come with wireless vital sign 3 or 5 lead ECG with trusted artifact free spO2 technology.
5.	The unit should come with wireless control room light weight monitor with base station having back up charging dock.
6.	It should be capable of monitoring ECG, SPO2, NIBP and Full Anesthetic gas module (including ETCo2) and 1 IBP.
7.	Clinical features : Standard
	— SpO2 with perfusion indicator : Wireless
	— ECG : 5 Lead : Wireless
	— Non-Invasive Blood Pressure
	— Dynamic Trend Indicators
	— Tri-colored alarm indicator light
	— Full gas module with ETCO2
	— Invasive Blood Pressure
	— Should be FDA marked
	— Accessories, MR compatible Laryngoscope
	● Vendor should provide the Pediatric & Adult SPO2 probes – 03 each.
	● Vendor should provide the Pediatric & Adult BP cuff – 03 each.
	Vendor should also quote the price for SPO2 probes & BP cuff for (adult & Pediatric) separately for further purchase if required.
8.	All the probes and accessories both for adult and pediatric age group should be provided for 10 years.

Annexure-3	
MR Compatible Anesthesia Machine	
Sl. No.	Description
	The system should be compatible with 3 T MRI systems (minimum 400 Gauss line) since it will be used with other MRI systems in case of need/ emergency. Should be, antistatic, heavy frame & base with good quality casters with front brakes, with following features :
1.	Three gas model viz. Oxygen, Nitrous oxide and Air.
2.	Should be compact, ergonomic, easy to use and easy to maintain.
3.	Should have separate fresh gas outlet for use in open circuit.
4.	Machine should have flow meters for Oxygen, Nitrous oxide and air. Emergency Oxygen flush should be available. There should be facility to select oxygen-air or oxygen-nitrous oxide with the help of a separate switch or knob.
5.	Flow sensing capability/pneumatic ventilator at inhalation and exhalation ports.
6.	Should have paramagnetic/ galvanic cell oxygen sensors. In case of galvanic cell sensors, the firm should supply free sensors for the entire warranty period of 5 years. In case of Paramagnetic sensors, the firm shall ensure that there is no down time during repair of these sensors (if necessary) and provide a standby alternative.
7.	Shall have back-up Oxygen Control which provides an independent fresh gas source and flow meter control in case of failure.
8.	Pressure regulators shall be of modular design.
9.	Should have oxygen fail safe device & an auxiliary built in oxygen flow meter.
10.	Electronic or Mechanical Hypoxic Guard to ensure minimum 25% Oxygen across all O2–N2O mixtures.
11.	Oxygen Failure Warning by audible alarm should be provided.
12.	The consumables like appropriate length of circuit, tubings, lines, etc should be provided for adults, Pediatric and neonates for a period of one year.
13.	Facility of mounting minimum two Vaporizers, latest technology, key filler, selectatec type, tool free installation, meaning any vaporizer of our choice can be mounted at will with interlocking facility. It should be preferably of the same make as that of machine.
14.	Temperature, pressure and flow compensated with high accuracy of delivered concentration of volatile Anesthetic agent. Should be maintenance free.
15.	Vaporizers should be supplied (Sevoflurane).Two vaporizers will be preferred if available.
16.	The Machine should have an Integrated Anesthesia Ventilator System, facility to vary respiratory parameters and should be able to ventilate adult and Pediatric patients including infants.
17.	Ventilator/pneumatically controlled time cycled ventilator should have Controlled, Manual, Spontaneous modes.
18.	Tidal volume (inspired and expired) respiratory rate, 1:E ratio, minute volume

	Airway pressure &FiO2 .
19.	Should have Tidal volume and fresh gas compensation mechanism.
20.	Tidal Volume (VT) 20-1500ml (Volume Control), Rate at least 4-80 BPM.
21.	Inspiratory / Expiratory ratio (I :E) 2:1 to 1:6 & Peak Flow -100 to 120 L/min.
22.	Ventilator should have at least 30min rechargeable battery backup for ventilator.
23.	Machine should have an integrated breathing circuit with circle absorber of good quality, easy to clean, autoclavable, fewer parts to reduce leaks.
24.	Machine should have mounting capability of One O2 and one N2O pin-indexed cylinder.
25.	Adult autoclavable (2 sets) breathing circuits & two pediatric circuit to be provided.
26.	The Machine should be equipped with AGSS.
27.	All the accessories should be provided for 10 years.
28.	Anesthesia workstation should be CE & USFDA approved.

Wiring System:

a) Light, Fan, 5 Amp Plug: 3 X 1.5 sq. mm copper conductor FRLS wire should be provided.

b) Power Plug (15 Amp): 2 X 2.5 + 1 X 1.5 sq. mm copper conductor FRLS wire should be provided.

c) Split AC wiring: 2 X 4 + 1 X 2.5 sq. mm copper conductor FRLS wire should be provided. Necessary electrical earthling facility is to be prepared.