

REVISED SYLLABUS FOR DEPARTMENTAL EXAMINATION FOR PROMOTION FROM SEA TO AE

PAPER – I

BROADCAST ENGINEERING

Pattern of the question Paper:

Out of nine questions Six questions are to be answered inclusive of question No. 1 which is compulsory. (Question No. 1 carries 20 marks and others carry 16 marks each)

1. Analog Electronics

- a) Vacuum tubes: Characteristics of power triodes and tetrodes, klystrons and TWT.
- b) Semi-conductor devices: Characteristics of general purpose diode and transistors, PIN diode, Tunnel diode, Photo diode Varactordiode, Thyristors, FET, MOSFET, integrated circuits, solid state microwave devices, circulators, isolators & wave guides.
- c) DC Power supply : rectifier, voltage regulators, thyristor, control of voltage & switched mode power supply. Thyristor controlled HT Rectifiers, Smoothing Circuits, Line Filters.
- d) Amplifiers : Single stage transistor amplifier in CE, CB, CC configuration; Grounded Grid Configuration, transistor biasing; transistors & stability; AF and RF small signal, large signal multistage, and operational amplifiers and application, negative feed back in amplifiers, Push Pull Amplifiers.
- e) Network theory : AC circuit analysis; series and parallel tuned circuits; power and impedance relations in the networks; network theory and application; two terminal and four terminal networks; attenuators, filters & equalisers. Active filters-low pass, high pass & band pass.
- f) Oscillators : Basic requirements for sustaining oscillations; AF low distortion and RF oscillators; frequency stability and crystal oscillators; Phase locked oscillator, monostable and bistable multivibrators; blocking oscillators; schmitt trigger; wave shaping; time base generators, synthesisers, mixer, phase comparator.
- g) Modulation and demodulation : Fundamentals of AM/FM & Digital modulation, PDM, PSM and power distribution in sidebands; frequency deviation & Bessel Zeros; various type of detector circuits; phase discriminators & phase locked loops; capture & lock range in PLL circuits.

2. Fibre Optic System

Optical Spectrum, Optical wave guide, Losses in optical fibres, Dispersion, Types of Optical Fibres, Optical Sources; LED, LASER and Comparison of LED & LASER.

3. Fundamentals of Digital Technology & Computer

Number systems; fundamental of Boolean algebra; basic logic gates; combinational and sequential logic circuits; registers; counters; semi-conductor memories; RAM, ROM, PROM, EPROM, various logic families; multiplexer, demultiplexer, encoders & decoders, analogue to digital and digital to analogue convertors. positive triggered and negative triggered latches, Microprocessor & Micro Controller.

Bit rate, Baud rate, Bit error rate, sampling, quantization (uniform & non-uniform), Encoder, Decoder Low pass filter, Audio/Video Compression Techniques, error correction codes, channel coding, Digital modulation techniques, ISDN (Integrated Service Digital Network)

Basic concepts/principles relating to Computer hardware, common application software packages and internet application, etc.

4. Electronic Measurements

Measurement of current, voltage, power, impedance, frequency and associated test and measuring instruments; cathode ray oscilloscope – its working and applications, spectrum analyser, log units – dB, dBm, dBu, dBr, dB(μ v/m).

5. Radio wave propagation :

Radio frequency spectrum allocation for Sound & TV broadcasting in AIR & DD; mechanism of propagation of Radio waves; ground, sky and space wave propagations; ionosphere & its role in long distance communication, Fresnel Zone.

6. Satellite Broadcasting

Orbital concept, various types of orbit of satellite, Geo-stationary orbit, Look angle, range of the satellite, concept of satellite communication, RF bands, concept & block diagram of transponder of the satellite. uplink/down link chain, link Budget, eclipse, Analog cum digital SCPC, Satellite Transmitter & receiver, SNG, Digital video broadcasting through satellite, IRD, DSNG.

PAPER – II (A)

RADIO ENGINEERING

Pattern of the Question Paper :

Question I is compulsory (Covers Transmitter & Studio) (20 Marks).

Part I – Sound Transmitter & Aerial Systems contains 5 Questions (16 Marks each)

Part II – Sound Studio System contains 5 Questions (16 Marks each)

Candidate has to answer 5 questions from Part I & II selecting atleast 2 questions from each part.

Part 1) Sound Transmitter & Aerial Systems

1. Studio-transmitter Programme Linkage

Working principle and characteristics of Non-exchange Telephone/FM/Analog and digital Microwave links.

2. Signal processing for input to the transmitter

Working principle and characteristics of equalisers. Importance of use of limiters and audio processors for AM and FM transmitters. Working principle, characteristics, detailed block diagram and line up procedure of AM/FM limiter.

3. Amplitude Modulated broadcast transmitters.

Amplitude Modulation Principles and Systems. RF and AF stages and their alignments. Additional features in New Generation AM Transmitters, grounded grid amplifier. Principles and working of class 'D' operation and D.C.C. for improving efficiency of AM transmitters. Principles of PWM, PSM and DSB. Combining and Diplexing of transmitters. Dummy Load, Cooling arrangements in high power transmitter, Control systems in old and new generation transmitters. AC and DC power supply systems for AM transmitters. Solid state PAs.

4. Transmitting aerials and feeders for AM broadcast transmitters.

Design consideration and characteristics of various types of transmitting aerials and feeders used with MW and SW broadcast transmitters; impedance matching of feeders with aerials; ATU. Diplexing and throw in problems, Directional antenna, beam changing.

Basic principles, fundamentals of transmission line, characteristic impedance, Types of losses in transmission lines, standing wave ratio, reflection coefficient, quarter and half wave length lines; Reactance properties of transmission lines, Impedance variation on mismatched transmission line. Smith Chart and its use.

5. Frequency modulated VHF broadcast transmitters aerials.

Principles of Frequency Modulation. Noise consideration in FM. Pre-emphasis and De-emphasis in FM transmitter. Block Diagram of FM Transmitter, New generation solid state transmitter. Block diagram, characteristics and working of different sections of the FM transmitter. Control Circuits, Characteristics of Pole/ Panel type Antenna and Feeder line used with the FM Transmitter. Combiner, 3dB coupler, Directional Coupler, Power dividers and matching of antenna. Use of Diplexer, Dehydrator. Remote operation of FM transmitter (Telemetry)

6. Power distribution and earthing arrangements at the transmitting stations :

Salient features of the sub-station and power supply distribution. Power, audio and RF earthing consideration. Safety Devices.

7. Performance measurement on transmitters and aerials.

Standard measurement required to be carried out for checking the performance of AM and FM radio broadcast transmitters and the condition of the aerial and feeder lines – their definitions, tolerance limits including frequency deviation/spurious harmonics and test benches.

Part 2) Sound Studio Systems

1. Nature of Sound

Characteristics of the human ear; frequency and amplitude range; reverberation of sound in enclosures;

2. Microphones

Working principle; characteristics and application of various type of microphones in radio broadcasting. Cordless microphones, Stereo Microphones. Phantom Power Supply.

3. Loudspeakers

Types and characteristics of loudspeakers for quality monitoring and listening of sound, Near Field Loudspeakers.

4. Recording/reproduction of sound

Principles of magnetic tape recording, Multi-track Recording, Stereo Recording, Console Tape Recorder, R-DAT, CD Player, CD Writer, Principles of Hard disc based Audio Recording, editing & playback. Concepts of Digital Audio compression. Turn Tables; their salient features, operational & maintenance practices. Use of standard tapes for aligning magnetic recording equipment. Use of standard CD for Audio measurements. Storage of recording media and archival practices.

5. Sound Studios

Salient features of a typical sound studio set-up in AIR and the technical facilities provided therein, audio schematic and signal levels in the studio chain of equipment; working principles and characteristics of various type of amplifiers and audio mixers including multi function stereo console. Audio Routine switcher, Active dubbing console, Phone in Equipment, Control of Reverberation Time and noise in studio. Types of Acoustic Treatment and Artificial Reverberation Time Generator.

6. Outside – broadcast

Salient features of the technical arrangements for coverage of outdoor events in the open and auditorium; working principle and characteristics of equipment in the OB Van. Portable OB recorders and mixers. PA system.

7. Reception of radio signals

Principles of AM and FM radio reception; characteristics of the domestic & communication receivers.

8. Performance measurements on sound equipment

Standard measurements required to be made on amplifiers, Mixers, Consoles, CD player, magnetic tape recorders & radio receivers – their definitions, tolerance limits and test benches.

9. Programme Networking

Analog/Digital Captive Earth Station and RN Terminal and their performance measurements.

PAPER – II (B)

TELEVISION ENGINEERING

Pattern of the Question Paper :

Question I is compulsory (Covers Transmitter & Studio) (20 Marks).

Part I – Television Transmitter, Aerial & Satellite Communication Systems contains 5 Questions (16 Marks each)

Part II – Television Studio Systems contains 5 Questions (16 Marks each)

Candidate has to answer 5 questions from Part I & II selecting atleast 2 questions from each part.

Part 1) Television Transmitters, Aerials & Satellite Communication Systems

1. Studio – transmitter programme link :

Working principle and characteristics of portable and fixed Studio Transmitter microwave links.

2. Signal processing for input to the transmitter

Working principles and characteristics of hum suppressors, stabilising amplifier and the video precorrectors.

3. Type of Modulation in TV transmitters

Types of modulation for the vision and sound RF carriers both in Analogue and Digital transmitters.

4. The High/Medium power VHF TV transmitters

Circuit considerations for the exciter stage of the vision and sound transmitters and for stabilization of carrier frequency; modulation of intermediate frequency; vestigial sideband shaping; power amplification of modulated vision and sound carrier; control, protective, monitoring and rectifier circuits and the arrangement for cooling of thermionic tubes in the transmitters; Solid State TV Transmitters including exciter, control and power amplifier stages; diplexing of the vision and the sound transmitter output power; Dummy load; characteristics of the high gain VHF/UHF antennae; arrangement for coupling the output power to the antennae; the characteristics of the low loss RF feeder cable; power and the audio/video earthing considerations.

5. The low and very low power VHF/UHF TV transmitters

The salient features of the LP/VLP TV transmitter equipment; characteristics of the transmitting aerials used with such transmitters.

6. Satellite Communication

Various types of uplink systems (permanent Earth Station, TRACT Vans, SNG, DSNG); Simulcast transmission. Calculation of Look Angles and Link Budget. Analogue/Digital, TVRO terminal equipment (including PDA, Feed & LNBC, etc.).

7. Performance measurements

Standard measurements required to be carried out for checking the performance of TV transmitters, microwave links and the TVRO terminal equipment, transmitting aerials, CNR measurement of Uplink/Downlink Chain.

Part 2) Television Studio Systems

1. TV Studio

- a) Salient features of a typical TV studio; video and audio schematic.
- b) The station synch pulse generator; block schematic of colour TV camera chain; working principles and characteristics of photo conductive plumbicon and the saticon tubes; TV camera optics; view finder; camera control; processing and encoding of video signal. Charge Coupled Devices (CCD) Cameras, Digital Cameras, Merits of CCD cameras over tube type Camera.
- c) The working principles of a vertical interval switcher; the switch matrix and the crosspoint; principle of mixing of video signals; vision mixer configurations; pattern generation; chroma keying and digital video effects; principle of genlocking and digital storage for timing remote signals into a system.
- d) Characteristics of lamps and fittings used for lighting in TV studios; the colour temperature of the light; light-level requirements, construction and working of light temperature meter and light level meters, Cold lights.
- e) Working principles of CCD telecine and the associated continuous motion film projector; sound on film and its reproduction; the frame store.
- f) Characteristics of various types of microphones used for pickup of TV sound and typical sound mixing desk required for TV applications.
- g) Principles of timing a colour studio system for ensuring synchronism of vision sources at a mixing point.

2. Video Tape Recording

Principles of magnetic tape recording of television signal, helical video tape recording formats; block schematic of a typical helical VTR; functional details of the tape transport, control system, servo system, video and audio signal processing circuits in helical VTR; timing errors in helical VTRs; working principles of digital time base corrector; electronic editing of video recordings; characteristics of video tapes and cassettes and their handling.

Betacam S.P., Digital VCRs. Various storage devices for video, concepts of video digital compression, Non linear editing systems. Paint Box for video graphics. Digital video library system.

3. TV Receiver

Block schematic of a colour TV receiver; working principles, sections of the modern colour TV receiver.

4. Outside broadcasts

Working principles and characteristics of TV OB Van and the microwave link equipment; arrangement for TV coverage of outdoor events.

Performance measurements

Standard test and measurements required to be performed on video; impairment of video signals – their definitions, tolerance limits methods of testing and the test benches.

PAPER – III

GENERAL SUBJECTS

Pattern of the question Paper:

Out of nine questions Six questions are to be answered inclusive of question No. 1 which is compulsory. (Question No. 1 carries 20 marks and others carry 16 marks each)

1. Safety precautions including First aid, etc. and Fire fighting.

- a) General information on safety, electricity rules, fire fighting equipment and first-aid equipment etc.
- b) Various safety precautions as detailed in section (1) of AIR Manual of Safety precautions.
- c) Safety precautions against electrical hazards as detailed in Section (2) of the Manual referred to above.
- d) Non-electrical hazards.
- e) Fire hazards.
- f) First-aid, artificial respiration etc.
- g) Reporting procedure for accidents and thefts.

2. Store purchase rules,

Stores, indents and purchases, receipt and issue, management of the stores, transit insurance, surplus, defective and unserviceable stores-disposal thereof, inventory control of transmitting tubes and other spares.

3. Principles of Power Supply systems, Air-conditioning and ventilation and Diesel Generators :

- a) Power Supply Distribution System(HT/LT Panel) Power factor and power factor correction, Types of HT/LT cables; Power supply systems operation and maintenance thereof. OCB, MOCB, ACB & VCB, Power Supply Safety devices, Over current, Earth fault, Series/Shunt trip coils, IDMT relay, Single phase preventer, etc.
- b) Internal combustion engines, principles, operation and maintenance thereof. Alternators, types of excitation. Governor and parallel operation of diesel generators.
- c) Various type AC plants, principles, operation and maintenance. Psychometric Charts. Airflow & tonnage calculation.
- d) Batteries, AC to DC conversion equipment, principles, operation and maintenance thereof, invertors, convertors & UPS, CVT, SMPS, AVR Isolation Transformers.

4. Installation/Projects

- a) Site selection of AIR/DD projects.
- b) Transmitter Installation.

- c) Studio installation.
- d) AC Plants and Diesel Generator.
- e) Use of measuring instruments like, Theodolite, Field Strength meter, Vector impedance bridge (VIM), Operating Impedance Bridge (OIB), Site Master, Side band Analyser, Spectrum Analyser, Audio Analyser, Sound level meters.
- f) Monitoring of project and installation activities.
- g) Extensive measurements, Joint Inspection, handing over of project.
- h) Earthing/shielding and earth resistance measurements.
- i) Maintenance of Accounts, Stores, Purchase and disposal.
- j) Various installation registers.
- k) Field Strength and Reception Survey
- l) Completion Report.

5. Station Management

- a) Leadership and Supervision : Nature of Leadership, Leadership Style.
- b) Communication : Communication Process, Barriers of Communication, Semantics of communication, Body Language, Listening.
- c) Inter-personal Relations.
- d) Conduct Rules, Discipline Rules and Fundamental Rules.
- e) Budget Management
- f) Security concepts.