DEPARTMENT OF COMMUNICATIONS

TELEVISION STATION OPERATOR'S CERTIFICATE OF PROFICIENCY

SECTION A - FUNDAMENTAL THEORY

Unless otherwise indicated the questions in this paper pertain to the Australian Television System.

December 1984

Time Allowed to read the Paper : 15 Minutes

Examination Time Allowed : 3 Hours

The questions on this paper have a number of alternative answers each of which is uniquely numbered. The candidates should clearly mark on the provided "Answer Sheet" the number corresponding to the preferred answer, by encircling it.

Every question has at least one correct answer and a few questions have more than one correct answer. An additional mark will be gained by correctly identifying such plural answers.

For every question attempted:

Marking the number corresponding to a correct answer gains one mark.

Marking any other number will result in the loss of one mark.

Failure to mark a correct answer involves no penalty.

Additional time is not allowed for marking up the "Answer Sheet" and it is therefore recommended that the "Answer Sheet" be marked up progressively as questions are completed.

The "Answer Sheet" is to be handed in to the supervisor at the conclusion of the examination. The examination paper may be retained by the candidate.

The pass mark in this paper is 60%.

SECTION A - 1984

Tick correct statement and draw a circle around the appropriate number on the Answer Sheet provided.

1. The nominal duration of the colour sub-carrier burst, measured between the half-amplitude points, is about:

2.5 microseconds	1
5.7 microseconds	2
10.0 microseconds	3

2. At the point of encoding, the peak-to-peak amplitude of the colour sub-carrier burst in a video signal, relative to the blanking to reference white amplitude, is approximately:

20%	4
40%	5
80%	6

3. In colour television transmissions, the colour sub-carrier burst occurs during the line blanking period. Taking the half amplitude point on the leading edge of the line synchronising pulse as reference, the burst commences after about:

1.6 microseconds	7
5.6 microseconds	8
16.6 microseconds	9

4. In a two-to-one interlaced television scanning system the field frequency is:

half the picture frequency	10
twice the picture frequency	11
the same as the picture frequency	12

5. The principal function of the sub-carrier burst in a colour television receiver is to:

maintain the correct phasing of the reproduced picture	13
maintain the correct phasing of the regenerated sub-carrier	14
maintain accurate clamping of the RGB signals	15

6. In the radiated television signal the tips of the synchronising pulses correspond to the :

minimum carrier power	16
average carrier power	17
peak carrier power	18

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7. The luminance synchronising signals enable the receiver to reconstruct the transmitted scene so that the picture details:

have correct voltage polarity	19
are reproduced with the correct tonal values	20
take up correct relative positions	21

8. The synchronising component for the luminance information in the composite video signal is transmitted:

time multiplexed with the video signal	22
frequency modulated with the video signal	23
independently from the video signal	24

9. In the most common method of deriving line synchronising information in a television receiver from the composite synchronising signal:

a decoding circuit is used	25
an integrating circuit is used	26
a differentiating circuit is used	27

10. The composite video signal is produced in a colour television studio by combining:

the luminance and chrominance components at camera outputs	28
the picture and sound signals	29
the picture signals with the synchronising information	30

11. In colour television receivers, the colour burst signal is separated from the video information by means of an amplifier which is operative only:

in the presence of the chrominance information	31
in the absence of the sub-carrier burst	32
during the period of the sub-carrier burst presence	33

12 In the Australian television system the transmitted line sychronising signal has the function, at the receiver, of:

deflecting vertically the scanning beam in the picture tube	34
maintaining the black level stability of the picture signal	35
initiating line flyback	36

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13. When the negative modulation process is used to transmit the video information in the Australian television system, an increase in image brightness causes:

a decrease in mean vision carrier amplitude 37
an increase in mean vision carrier amplitude 38
no change in mean vision carrier amplitude 39

14. The negative modulation process, which is used to transmit the video information, offers the advantage of:

the RF noise peaks resulting in black spots or streaks in the reproduced picture 40
the tips of the synchronising pulses representing minimum carrier level 41
the improved synchronising noise immunity in television receivers 42

15. The build-up time, from 10 to 90 per cent amplitude of the edges of the blanking pulses in a radiated television signal, is about:

0.03 microsecond 43
0.30 microsecond 44
3.00 microseconds 45

16. The horizontal resolution of a television system basically depends on:

the number of scanning lines used 46
the dimensions of the receiver picture screen 47
the working video bandwidth of the transmitter-receiver system 48

17. The luminance component of a three-tube colour camera is formed by adding:

the U and V modulator outputs 49
the chrominance component to the colour difference signals 50
the gamma corrected colour camera output voltages 51

18. For a given definition and flicker content a television system using interlaced scanning, compared with a sequential scanning system, occupies:

a smaller video frequency bandwidth 52
a larger video frequency bandwidth 53
the same video frequency bandwidth 54

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19. A vestigial sideband transmission means a double sideband modulated signal with:

both sidebands significantly suppressed 55
one sideband partially suppressed 56
an associated FM sound carrier 57

20. In the Australian television system, in the VHF channels, the vision carrier is located:

1.25 MHz above the lower frequency limit of the channel 58
4.43 MHz above the lower frequency limit of the channel 59
5.00 MHz above the lower frequency limit of the channel 60

21. In the Australian television system, the nominal width of the vestigial sideband is:

0.75 MHz 61
1.25 MHz 62
4.43 MHz 63

22. In the Australian television system the colour-difference signals are derived in a circuit which is called a matrix. One of the essential properties of a matrix is that it must be capable of:

providing a method of signal combination with the minimum interaction between the various input sources 64
adding the luminance component to the gamma corrected primary colour voltages 65
dividing the luminance component by the gamma corrected primary colour voltages 66

23. The chrominance signal sidebands in the radiated colour vision signal are shaped in the transmitter. The attenuation slope of the upper sideband is dictated by the upper edge of the system's vision channel characteristics, but the lower sideband slope is:

extended to the vision carrier 67
made identical to that of the upper sideband 68
made less steep than that of the upper sideband to ensure optimum colour reproduction 69

24. In the Australian television system, the chrominance component of the radiated colour video signal is formed by:

subtracting the colour-difference signals from the luminance component 70
modulating the colour-difference signals onto the sub-carrier ~~colour~~ 71
adding the colour-difference signals in quadrature 72

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25. In the PAL television system the numerical value of the colour sub-carrier is selected to ensure that when the colour signal is received by monochrome receivers:

    the visibility of the dot-pattern interference is minimised 73
    the intermediate frequency stability of receivers is unimpeded 74
    the visual signal energy is uniformly distributed throughout the channel bandwidth 75

26. The station colour sub-carrier frequency must be maintained constant within:

    ± 1 Hz 76
    ± 5 Hz 77
    ± 100 Hz 78

27. The relationship between the electrical signal input to a television receiver picture tube and its light output is described by the term:

    luminous efficiency 79
    luminous flux 80
    gamma 81

28. Tonal gradation relates to the ability of the television system to accurately reproduce:

    primary colours having appropriate luminance 82
    colours having different degrees of saturation 83
    brightness levels of televised scenes between the extremes of black and white 84

29. When a white video signal is applied to the input of a television amplifier having a gamma characteristic of unity, the amplitude of the signal relative to its black level will be:

    expanded 85
    compressed 86
    amplified linearly 87

30. The shorter wavelength components in the visible light spectrum correspond to:

    blue light 88
    green light 89
    red light 90

31. In the visible light spectrum between 400 and 700 nanometres (nm) the human eye is most sensitive at approximately:

460 nm	91
560 nm	92 ✓
660 nm	93

32. In colour television, the term "colour temperature" is used in relation to:

the degree of colour saturation produced	94
the actual surface temperature of the studio light source	95
the surface temperature of an equivalent black body radiator	96 ✓

33. In the study of optical systems light is regarded as being of the same nature as radio waves but of:

very much higher velocity of propagation	97
very much longer wavelength	98
very much shorter wavelength	99 ✓

34. When the eye is used to match a speciment colour stimulus, using three primary colours, one necessary condition is that:

the sum of the luminances of the three primaries is equal to the luminance of the specimen	100 ✓
the luminances of each of the three primary sources are equal	101
the luminances need not match	102

35. The primary colours used in the colour television system are:

red, green and blue	103 ✓
yellow, green and blue	104
white, green and blue	105

36. A coloured light, which is composed of light energy in the form of only one frequency, is said to be:

monochromatic	106 ✓
gamma corrected	107
desaturated	108

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37. A colour reproduced on a television screen is said to be fully saturated when:

it is made up of special proportions of all three primary colours	109
it is made up of any single primary or a pair of primary colours	110
it does not contain any white light	111 ✓

38. A standard white source (e.g. fluorescent tube matched to Illuminant D65) is used in television colour studios to align the colour picture monitors to ensure that:

studio cameras are correctly colour balanced and matched	112 ✓
the monochrome reception is compatible	113
the vision transmitters are fully modulated	114

39. In the PAL colour television system colours are reproduced on the picture screen of receivers by:

adding coloured lights	115 ✓
separating out complementary colours	116
eliminating primary colours	117

40. A colour impression may be produced on a television screen when certain other colours are combined in appropriate proportions. Which of the following combinations can produce cyan colour?

green and red	118
blue and red	119
blue and green	120 ✓

41. In the PAL colour television system the colour sub-carrier frequency has the nominal value:

3.57861875 MHz	121
4.43361875 MHz	122 ✓
4.43751875 MHz	123

42. The luminance component, E'_Y, of a colour video signal is produced by addition of:

the red and blue colour camera output voltages	124
the colour-difference signal voltages	125
the three gamma-corrected colour camera output voltages	126 ✓

43. In the PAL television system, the colour information is transmitted by means of a single colour sub-carrier. In the process of modulation the sub-carrier is:

frequency modified	127
suppressed	128 ✓
phase shifted by 235°	129

44. The chrominance component of a colour television transmission is derived from:

gamma-corrected colour camera output voltages 130
phase-inverted luminance component voltages 131
two colour-difference signal voltages 132✓

45. A colour triangle on the CIE chromaticity diagram:

indicates the brightness of a colour mixture 133
defines the white point for the system using three primaries represented at the apices of the triangle 134
indicates the range of chromaticities definable by mixing the colours represented at the apices of the triangle 135✓

46. In a PAL colour encoder the colour sub-carrier input signal to one of the balanced modulators is periodically inverted by an electronic pulse-switching circuit in order to:

reverse the phase of the chrominance signal on alternate lines 136
enhance operational efficiency of the associated balanced modulators 137
simplify the design of colour receiver demodulator circuitry 138

47. In the PAL television system, the transmitter colour sub-carrier and its sidebands are interleaved with the sidebands of the luminance carrier. To make this technique effective the sub-carrier frequency must be:

an odd multiple of one quarter of the line frequency 139✓
an even multiple of half the line frequency 140
variable over a range of frequencies 141

48. For a given colour impression in a colour television system, the colour saturation information is transmitted as:

the amplitude of the vision carrier 142
the phase of the colour sub-carrier sidebands 143
the amplitude of the colour sub-carrier sidebands 144✓

49. In a PAL colour decoder, the 7.8 kHz identification signal is derived from the output of a phase detector. One of the functions of this signal is to ensure that:

the colour sub-carrier oscillator output is locked up with the correct phase 145
the function of the colour killer circuit is held off 146✓
the phase inversion of the U signal on alternate lines is in step with that at the encoder 147

50. In the PAL colour television receiver synchronous demodulators are used in the chrominance path to recover:

and process the luminance component of the video signal	148
two of the colour-difference signals	149 ✓
and process the colour synchronising information	150

51. In the PAL television system, the colour information is transmitted by means of a single colour sub-carrier. The double sideband modulation system used for this purpose allows the transmission:

of colour-difference signals when the picture detail is non-coloured	151
of modulated colour sub-carrier at all times	152
of an independently modulated chrominance component directly related to the relevant luminance signal	153 ✓

52. In the PAL television system, a problem associated with the use of suppressed sub-carrier transmission of the chrominance signal is related to the need for:

an intermediate operation of the colour sub-carrier oscillator in the transmitter	154
improving the contrast stability of monochrome transmissions	155
a stable reference oscillator in the receiver	156 ✓

53. In the PAL-D receiver, the U and V chrominance components are recovered from the composite video signal by means of:

a chrominance delay line and associated circuits	157 ✓
burst gate amplifiers	158
luminance bandpass amplifiers	159

54. In the chrominance circuits of a colour receiver a colour-killer circuit is provided to automatically disable the chrominance circuitry during monochrome transmissions. The main purpose for the circuit is:

to improve the contrast of monochrome transmissions	160
to prevent random information in the luminance signal causing colour interference on the screen	161 ✓
to reduce the visibility of the annoying dot pattern	162

55. In the PAL-D colour television receivers, the setting of the synchronous demodulators forms an important part of the receiver alignment. An incorrect setting of the phases of the two sub-carriers will result in:

excessive amplitudes of the regenerated colour-difference signals	163
an incorrect hue	164 ✓
an accentuated colour saturation of the reds	165

56. For satisfactory operation of synchronous demodulators in the PAL-D colour television receivers, the amplitude of the re-inserted sub-carrier from the reference oscillator, relative to the chrominance signal amplitude, should be:

greater 166
equal 167
smaller 168

57. In the PAL colour television receiver, the recovery of the E'_G-E'_Y colour-difference signals is usually achieved by means of its:

fixed and automatically transmitted numerical relationship with the other two colour-difference signals 169
suitability for non-symmetrical demodulation 170
adaptability to colour-corrective filtering 171

58. In a colour television studio, when two different picture sources are used in the same programme, it is necessary to ensure that both sources are operating:

at the same field but not necessarily line frequencies 172
with the fields locked in phase in the correct four-field PAL sequence 173
with the PAL alternation being different on each field 174

59. The unit of luminous flux is the:

lux 175
lumen 176
candela per square metre 177

60. The term "illumination" is used to describe:

the brightness of a surface 178
the concentration of luminous flux falling upon a surface 179
the concentration of luminous flux radiated by, or reflected, from a surface 180

61. The unit of illumination is the:

lumen 181
lux 182
candela per square metre 183

62. One lux is equal to:

one lumen per square metre (lm/m^2) 184
one lumen per square centimetre (lm/cm2) 185
One lumen per square foot (lm/ft^2) 186

63. Dichroic mirrors are used in the television optical systems of colour cameras to:

reflect light uniformly over the visible spectrum 187
absorb parts of the visible spectrum and transmit the remainder
reflect selectively parts of the visible spectrum and transmit the remainder 188
189

64. Special prism-type optical systems are used in colour cameras, in preference to parallel-plate dichroic mirrors:

to reduce operating costs of studio equipment 190
to avoid secondary images by undesirable highlight reflections
to simplify maintenance and replacement of optical equipment 191
192

65. In a three-tube colour camera the most critical tube as regards registration is:

the red tube 193
the luminance tube 194
the green tube 195

66. The light input to light output characteristics of the Australian transmission system for colour television is not linear, owing to the fact that the camera and receiver cathode ray tubes are inherently non-linear. This non-linearity is usually improved by:

voltage stabilisation
~~operature~~ correction 196
gamma correction 197
198

67. The tubes and associated amplifier circuits of a three-tube colour camera should be of high-definition broad-band type and the tubes should be:

of identical colour responses 199
selected to give the best response each in its own colour channel
different in their light transfer characteristics to the characteristics of the receiver picture tubes 200
201

68. In some colour television cameras, a better quality compatible monochrome picture is produced when:

one of the dichroic filters is removed from the camera 202
a separate luminance tube is incorporated into the camera
the output signals of the individual colour tubes are noticeably mismatched 203
204

69. The local length of a lens used in the optical system of a television camera is:

related to the radius of curvature of one of the two spherical surfaces of the lens	205
related to the radii of curvature of the two spherical surfaces of the lens	206 ✓
not related to the radii of curvature of the two spherical surfaces of the lens	207

70. The diameter of the entrance pupil of a lens system in photographic and television cameras is usually defined as the ratio of:

the illumination falling on the lens system to the light transmitted through the system	208
the length of the diagonal of the target image to the focal length of the lens	209
the focal length of the system to the system's aperture ratio	210 ✓

71. In a studio colour television camera, the image illumination varies:

inversely as the square of the f-number	211 ✓
directly as the square of the f-number	212
directly as the square of the object distance	213

72. An increase in the aperture of an optical lens system:

increases its depth of field	214
decreases its depth of field	215 ✓
does not affect its depth of field	216

73. The effect of spherical aberration of a lens is normally evident:

at the centre of the image field	217
at the periphery of the image field	218
all over the image field	219 ✓

74. If the magnification of a lens system varies with the distance of an image from the centre of the image field, the system will produce:

spherical aberration	220
axial chromatic aberration	221
pincushion or barrel distortion	222 ✓

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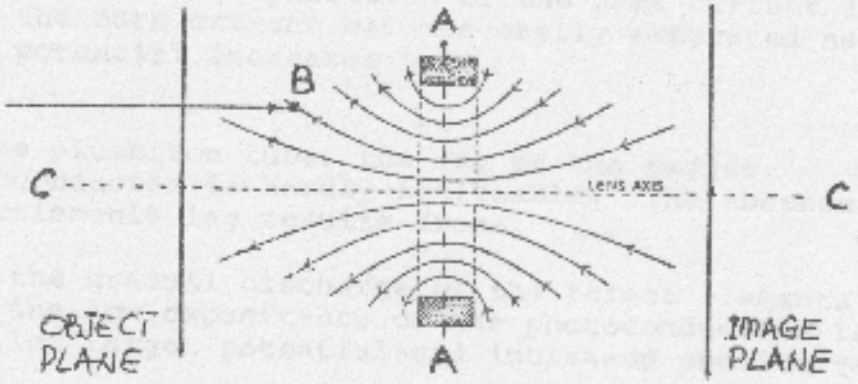
75. In a picture tube of a colour television receiver the velocity acquired by an electron, which has moved from rest through a potential difference V, is:

proportional to the square root of the potential difference 223
inversely proportional to the square of the potential difference 224
independent of the potential difference 225

Questions 76, 77 and 78 are based on the following information:

A simple short magnetic lens is shown below. The magnetic field within the lens is depicted by the full lines.



76. An electron approaches the lens from the left and travels along a path which is at right angle to the Object Plane. At point B the electron will:

experience a retarding force 226
be deflected towards the axis C.C. 227
be deflected away from the axis C.C. 228

77. An electron travelling along the axis C.C. will:

exhibit a spiral motion about the axis as it approaches the centre of the lens A.A. 229
continue to travel along the axis 230
be deflected away from the axis 231

78. Electrons which entre the lens from the left along paths parallel to the axis C.C. but at different distances from the axis:

are caused by the deflecting forces to meet the axis C.C. at a common point 232
are caused by the deflecting forces to meet at a common point away from the axis C.C. 233
are caused to diverge 234

79. The sensitivity of the beam deflection system commonly used in television receiver picture tubes is:

inversely proportional to the distance of the screen from the centre of the deflection field 235
inversely proportional to the magnitude of the deflection field 236
directly proportional to the length and magnitude of the deflection field 237✓

80. The dark current of a plumbicon camera tube can be likened to the characteristic reverse-biased diode current. Because of this:

the black level uniformity of pictorial information is poor in well lit scenes 238
the absolute variation of the dark current is large 239
the dark current becomes easily saturated as target potential increases 240✓

81. In the plumbicon tube, the lag of the target photoconductor is hardly noticeable. The absence of objectionable lag results from:

the gradual discharge of the target elements 241
the low capacitance of the photoconductive layer 242✓
low target potential and increased photocurrent 243

82. A spurious effect known as beam pulling can occur in plumbicon camera tubes. This effect is caused by:

maladjusted registration correction controls 244
a highly charged image pattern on the beam side of the target 245✓
excessive beam current 246

83. The beam pulling is characterised by:

improvement in vertical resolution within high-light areas 247
expansion at the edges of high-light areas 248✓
misregistration by pulling at horizontal transitions 249

84. In a television camera chain the term "geometric distortion" refers to:

non-uniform grey scale reproduction 250
inaccurate reproduction of the position of scene details 251✓
non-uniform illumination over the scanned area 252

85. In a shadow-mask picture tube, colour purity corrections or adjustments are sometimes required to ensure that:

proper grey-scale tracking is possible in the corner areas 253
the corner resolution is acceptable 254
the individual scanning beams illuminate only their respective phosphors 255✓

86. In a shadow-mask picture tube correct registration of the three rasters at the edge of the picture is achieved by:

adjustment of dynamic convergence currents 256✓
adjustment of static magnetic fields 257
axial movement of the deflection yoke 258

87. In a colour television receiver, grey scale tracking adjustments are necessary:

to ensure colour purity at all contrast levels 259
to ensure colour tinting on monochrome transmissions 260
to compensate for the different operational characteristics of the electron guns used in the receiver 261✓

88. In a domestic colour receiver provision is made for degaussing to be effected by passing a burst of strong mains current through a special coil:

when the receiver is first switched on 262✓
periodically when the receiver is operating 263
when the receiver is switched off 264

89. The trinitron colour picture tube represents an improvement in colour television cathode ray tube technology because:

the size of its screen phosphor dots is much smaller 265
it operates at a substantially lower current density of its scanning beam 266
its aperture grill has a greater electron transparency than the shadow mask 267✓

90. A symmetrical bistable multivibrator generates a rectangular output waveform:

at a repetition rate determined by its circuit time constants 268
the duration of which is determined primarily by its circuit time constants 269
the duration of which is determined by two consecutive trigger pulses 270✓

91. Blocking oscillators are used in television receivers to generate sawtooth waveforms for beam deflection purposes. For a satisfactory operation of a blocking oscillator, the following conditions must be observed:

the value of the mutual conductance of the active element in the circuit need not be high	271
the magnetic coupling between the inductor coils in the collector and the base circuits must be very tight	272 ✓
the bias voltage of the base circuit need not be driven negative during the flyback periods	273

92. When blocking oscillators are used for waveform generation, the output sawtooth is normally produced by:

a resistor and capacitor combination in the collector circuit	274
a resistor and capacitor combination in the emitter circuit	275
an inductor and resistor combination in the base circuit	276 ✓

93. Binary-counter circuits are used in synchronising pulse generators for pulse counting and frequency division purposes. A unit consisting of three binary counters with a feed-back loop connecting the output of the third counter to the inputs of the first and the second, respectively, is used in a frequency divider. The ratio of input pulses to output will be:

3:1	277
5:1	278 ✓
7:1	279

94. In the circuitry handling video signals, the primary purpose of a D.C. restorer in the system is to maintain at a constant magnitude:

the modulation levels in the television transmitter	280
the video signals output at the receiver	281
the low frequency component of a video signal	282

95. In television measurement practices, variation of small signal chrominance gain as a function of instantaneous level of luminance signal is referred to as:

differential gain	283 ✓
differential phase	284
amplitude response	285

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96. In the Australian television service the ratio of the peak envelope power of the vision transmitter to the mean power of the sound transmitter has a nominal (decibel) value of: (mono sound transmission case)

3 dB 286
6 dB 287
10 dB 288 ✓

97. The performance of a video amplifier can be improved by including in it certain circuits which have the effect of improving its frequency response at the upper end of the video band. The frequency phenomenon of overshoot occurs because of:

the reduction in the rise time of the signal being ampified 289
the reduction in the working passband of the amplifier 290
the resultant disturbance in the phase relationships between various frequency component of the amplified signal 291 ✓

98. In television transmission measurement practices, a five-step staircase with superimposed sub-carrier is used to measure:

sideband response 292
differential phase distortion 293 ✓
geometric distortion of the link equipment 294

99. In the Australian television service, chrominance-luminance crosstalk is measured by means of the chrominance bar included in the chrominance-luminance pulse and bar waveform. The effect of this distortion is:

to alter the horizontal position of the chrominance signal along the bar 295
to alter the position of the mean level of the chrominance signal 296 ✓
to reduce the amplitude of the upper portion of the chrominance signal 297

100. A square pulse with sharp vertical sides is useful to test video processing equipment in a television studio. One of the reasons for its usefulness is that:

it is not affected by the phase response deficiencies 298
its horizontal section is not affected by the low frequency deficiencies 299
it contains frequency components over the entire television channel bandwidth 300 ✓