



**AQA A-level Physics Year 2**

Scheme of Work – Optional Units

Scheme of Work

AQA A-level Physics Year 2 of A-level

This course covers the requirements of the second year of AQA AS and A-level Physics specification. These schemes of work are designed to accompany the use of Collins’ AQA A-level Physics Year 2 Student Book.

We have assumed that 120 one-hour lessons are taught during the year, 95 of which will cover the Specification’s Core units. Each lesson is matched to the Specification content. It is suggested in which lessons the six Required Practicals may be carried out.

Outline schemes have been provided for each of the five Option units, allowing 25 lessons for each.

The schemes of work suggested are of course flexible, and editable, to correspond with your timetabling and to enable you to plan your own route through the course. Time is allowed in the schemes for consolidation and exam questions practice at the end of each topic. This should help enable students to draw together all their knowledge from earlier in the course.

Scheme of Work

AQA A-level Physics Year 2 of A-level

Option Unit: Astrophysics (25 hours)

| **One-hour lessons** | **Specification Content** |
| --- | --- |
| **CHAPTER 11 TELESCOPES** (6 hours) |
| 1 | 3.9.1.1 Astronomical telescope consisting of two converging lensesRay diagram to show the image formation in normal adjustmentFocal lengths of the lensesAngular magnification in normal adjustment*M* = *M* =   |
| 2 | 3.9.1.2 Qualitative treatment of spherical and chromatic aberration 3.9.1.2 Reflecting telescopes Cassegrain arrangement using a parabolic concave primary mirror and convex secondary mirrorRay diagram to show path of rays through telescope up to the eyepieceRelative merits of reflectors and refractors  |
| 3 | 3.9.1.4 Minimum angular resolution of telescope Rayleigh criterion, *θ* ≈ *λ*/*D* Students should be familiar with the rad as the unit of angleCollecting power is proportional to diameter2  |
| 4 | 3.9.1.3 Single dish radio telescopes, I-R, U-V and X-rays telescopesSimilarities and differences of radio telescopes compared to optical telescopesDiscussion should include structure, positioning and use, together with comparisons of resolving and collecting powers  |
| 5 | 3.9.1.4 Comparison of the eye and CCD as detectors in terms of quantum efficiency, resolution, and convenience of useNo knowledge of the structure of the CCD is required  |
| 6 | *(Consolidation and exam questions practice)* |
| **CHAPTER 12 CLASSIFICATION OF STARS** (6 hours) |
| 1 | 3.9.2.1 Classification by luminosityApparent magnitude, *m*The Hipparchus scale Dimmest visible stars have a magnitude of 63.9.2.3 Inverse square law, assumptions in its application3.9.2.1 Relation between brightness and apparent magnitude. Difference of 1 on magnitude scale is equal to an intensity ratio of 2.51Brightness is a subjective scale of measurement *(Maths review of manipulation of logarithms)* |
| 2 |
| 3 | 3.9.2.2 Absolute magnitude, *M*Parsec and light yearDefinition of *M*, relation to *m*:*m* – *M* = 5 log  |
| 4 | 3.9.2.3 Classification by temperature, black-body radiationStefan's law *P*  = *σAT*4and Wien's displacement law *λ*max*T* = constant = 2.9 × 10–3 m K General shape of black-body curves, use of Wien’s displacement law to estimate black-body temperature of sourcesExperimental verification is not requiredAssumption that a star is a black bodyUse of Stefan's law to compare the power output, temperature and size of stars |
| 5 | 3.9.2.4 Principle of the use of stellar spectral classesDescription of the main classes:Temperature related to absorption spectra limited to hydrogen Balmer absorption lines: requirement for atoms in an *n* = 2 state |
| 6 | *(Consolidation and exam questions practice)* |
| **CHAPTER 13 STELLAR EVOLUTION** (6 hours) |
| 1 | 3.9.2.5 The Hertzsprung-Russell (HR) diagramStellar evolution *(general overview from protostar to stable main sequence star)*General shape (of HR diagram): main sequence, dwarfs and giantsAxis scales range from –10 to +15 (absolute magnitude) and 50 000 K to 2500 K (temperature)or OBAFGKM (spectral class)Students should be familiar with the position of the Sun on the HR diagramStellar evolution: path of a star similar to our Sun on the HR diagram from (main sequence) to white dwarf |
| 2 |
| 3 | 3.9.2.6 Supernovae, neutron stars and black holesDefining properties: rapid increase in absolute magnitude of supernovae; composition and density of neutron stars  |
| 4 | 3.9.2.6 Escape velocity > *c* for black holesCalculation of the radius of the event horizon for a black hole, Schwarzschild radius, Rs ≈ 2*GM*/*c*2Gamma ray bursts due to the collapse of supergiant stars to form neutron stars or black holesComparison of energy output with total energy output of the Sun Supermassive black holes at the centre of galaxies |
| 5 | 3.9.2.6 Use of type 1a supernovae as standard candles to determine distancesStudents should be familiar with the light curve of typical type 1a supernovaeControversy concerning accelerating Universe and dark energy *(introduction)* |
| 6 | *(Consolidation and exam questions practice)* |
| **CHAPTER 14 COSMOLOGY** (7 hours) |
| 1 | 3.9.3.1 Doppler effectΔ*f*/*f* = *v*/*c**z* = Δλ/λ = –v/cfor *v* << *c* applied to optical and radio frequencies |
| 2 | 3.9.3.1 Calculations on binary stars viewed in the plane of orbitGalaxies and quasars |
| 3 | 3.9.3.2 Hubble’s lawRecession velocity *v* = *Hd* Simple interpretation as expansion of universe; estimation of age of universe, assuming *H* is constant Qualitative treatment of Big Bang theory 3.9.2.6 Controversy concerning accelerating Universe and dark energy |
| 4 | 3.9.3.2 Qualitative treatment of Big Bang theory including evidence from cosmological microwave background radiation, and relative abundance of hydrogen and helium |
| 5 | 3.9.3.3 QuasarsQuasars as the most distant measurable objectsDiscovery of quasars as bright radio sourcesQuasars show large optical red shifts; estimation involving distance and power outputFormation of quasars from active supermassive black holes  |
| 6 | 3.9.3.4 Detection of exoplanetsDifficulties in the direct detection of exoplanetsDetection techniques will be limited to variation in Doppler shift (radial velocity method) and the transit methodTypical light curve  |
| 7 | *(Consolidation and exam questions practice)* |

Option Unit: Medical Physics (25 hours)

| **One-hour lessons** | **Specification Content** |
| --- | --- |
| **CHAPTER 15 PHYSICS OF THE EYE AND THE EAR** (9 hours) |
| 1 | 3.10.1.1 Physics of visionThe eye as an optical refracting system Sensitivity of the eye; spectral response as a photodetectorSpatial resolution of the eye; explanation in terms of the behaviour of rods and cones |
| 2 | 3.10.1.2 Defects of vision and their correction using lensesProperties of converging and diverging lenses; principal focus, focal length and power  3.10.1.1 The eye as an optical refracting system, including ray diagrams of image formation |
| 4 | 3.10.1.2 Myopia, hypermetropia, astigmatismRay diagrams and calculations of powers (in dioptres) of correcting lenses for myopia and hypermetropia The format of prescriptions for astigmatism *(Consolidation and exam questions practice)* |
| 5 |
| 6 | 3.10.2.1 Ear as a sound detection systemSimple structure of the ear, transmission processes   |
| 7 | 3.10.2.2 Sensitivity and frequency response Definition of intensityHuman perception of relative intensity levels and the need for a logarithmic scale to reflect this*(Review of properties of logarithms)*Intensity level = 10 log (*I*/*I*0) where the threshold of hearing *I*0 = 1.0 × 10–12 W m–2Measurement of sound intensity levels and the use of dB scale; relative intensity levels of sounds |
| 8 | 3.10.2.2 Production and interpretation of equal loudness curves Measurement of sound intensity levels and the use of dBA scale |
| 9 | 3.10.2.3 Defects of hearingThe effect on equal loudness curves and the changes experienced in terms of hearing loss due to injury resulting from exposure to excessive noise or deterioration with age (excluding physiological changes)*(Consolidation and exam questions practice)* |
| **CHAPTER 16 BIOLOGICAL MEASUREMENTS** (2 hours) |
| 1 | 3.10.3.1 Simple ECG machines and the normal ECG waveform Principles of operation for obtaining the ECG waveform; explanation of the characteristic shape of a normal ECG waveform*(Consolidation and exam questions practice)* |
| 2 |
| **CHAPTER 17 NON-IONISING IMAGING** (5 hours) |
| 1 | 3.10.4.1 Ultrasound imaging Piezoelectric devicesPrinciples of generation and detection of ultrasound pulses Reflection and transmission characteristics of sound waves at tissue boundaries, acoustic impedance, *Z*, and attenuationUse of the equations *Z* = *ρc* and  |
| 2 | 3.10.4.1 A-scans and B-scans Examples of applications  Advantages and disadvantages of ultrasound imaging in comparison with alternatives including safety issues and resolution |
| 3 | 3.10.4.2 Fibre optics and endoscopy*(Review of total internal reflection and optical fibres)*Properties of fibre optics and applications in medical physics; including total internal reflection at the core–cladding interfacePhysical principles of the optical system of a flexible endoscope; the use of coherent and non-coherent fibre bundles; examples of use for internal imaging and related advantages |
| 4 | 3.10.4.3 Magnetic resonance (MR) scannerBasic principles of MR scanner including:- cross-section of patient scanned using magnetic fields- protons initially aligned with spins parallel- spinning hydrogen nuclei (protons) precess about the magnetic field lines of a superconducting magnet- ‘gradient’ field coils used to scan cross-section- short radio frequency (RF) pulses cause excitation and change of spin state in successive small regions- protons excited during the scan emit RF signals as they de-excite- RF signals detected and the resulting signals are processed by a computer to produce a visual imageStudents will not be asked about the production of magnetic fields used in an MR scanner, or about de-excitation relaxation times  |
| 5 | *(Consolidation and exam questions practice)* |
| **CHAPTER 18 X-RAY IMAGING** (4 hours) |
| 1 | 3.10.5.1 The physics of diagnostic X-raysPhysical principle of the production of X-rays; maximum photon energy, energy spectrum; continuous spectrum and characteristic spectrum Rotating-anode X-ray tube; methods of controlling the beam intensity, the photon energy, the image sharpness and contrast, and the patient dose |
| 2 | 3.10.5.2 Image detection and enhancementFlat panel (FTP) detectors including X-ray scintillator, photodiode pixels, electronic scanningAdvantages of FTP detector compared with photographic detection3.10.5.2 Contrast enhancement; use of X-ray opaque material as illustrated by the barium meal techniquePhotographic detection with intensifying screen and fluoroscopic image intensification; reasons for using these  3.10.5.3 Absorption of X-raysExponential attenuation*(Review of exponentials and logarithms)*Linear coefficient *μ*, mass attenuation coefficient *μ*m , half-value thickness*I* = *I*0 e–*μx* *μ*m = *μ*/*ρ*Differential tissue absorption of X-rays excluding details of the absorption process  |
| 3 |
| 4 | 3.10.5.4 CT scannerBasic principles of CT scanner:- movement of X-ray tube- narrow, monochromatic X-ray beam- array of detectors- computer used to process the signals and produce a visual image*(Comparison of imaging techniques)*Comparisons will be limited to advantages and disadvantages of image resolution, cost and safety issuesStudents will not be asked about the construction or operation of the detectors *(Consolidation and exam questions practice)* |
| **CHAPTER 19 RADIONUCLIDE IMAGING AND THERAPY** (5 hours) |
| 1 | 3.10.6.2 Half-life*(Review of radioactive decay)*Physical, biological and effective half-lives:Definitions of each term |
| 2 | 3.10.6.1 Imaging techniquesUse of a gamma-emitting radioisotope as a tracer; technetium-99m, iodine-131 and indium-111 and their relevant propertiesThe properties should include the radiation emitted, the half-life, the energy of the gamma radiation, the ability for it to be labelled with a compound with an affinity for a particular organ |
| 3 | 3.10.6.1 The Molybdenum-Technetium generator, its basic use and importancePET scans |
| 4 | 3.10.6.3 Gamma cameraBasic structure and workings of a photomultiplier tube and gamma camera3.10.6.4 Use of high-energy X-rays External treatment using high-energy X-raysMethods to limit exposure to healthy cells  |
| 5 | 3.10.6.5 Use of radioactive implantsInternal treatment using beta-emitting implants 3.10.6.6 Imaging comparisonsStudents will be required to make comparisons between imaging techniques. Questions will be limited to consideration of image resolution convenience and safety issues. *(Consolidation and exam questions practice)* |

Option Unit: Engineering Physics (25 hours)

| **One-hour lessons** | **Specification Content** |
| --- | --- |
| **CHAPTER 20 ROTATIONAL DYNAMICS** (10 hours) |
| 1 | 3.11.1.3 Rotational motionAngular displacement, angular speed, angular velocity, angular acceleration  |
| 2 | 3.11.1.1 Concept of moment of inertia*I* = *mr*2 for a point mass*I* = Σ*mr*2 for an extended objectQualitative knowledge of the factors that affect the moment of inertia of a rotating objectExpressions for moment of inertia will be given where necessary |
| 3 | 3.11.1.4 Torque and angular acceleration*T* = *Fr* *T* = *Iα* 3.11.1.3 Rotational motionEquations for uniform angular acceleration:*ω*2 = *ω*1 + *αt**θ* = ½(*ω*2 + *ω*1)*t* *θ* = ω1*t* + ½*αt*2*ω*22 = *ω*12 + 2*αθ*Students should be aware of the analogy between rotational and translational dynamics  |
| 4 | 3.11.1.3 Rotational motionRepresentation by graphical methods of uniform and non-uniform angular acceleration |
| 5 | 3.11.1.2 Rotational kinetic energy*E*k = ½*Iω*2 Factors affecting the energy storage capacity of a flywheel |
| 6 |
| 7 | 3.11.1.2 Rotational kinetic energy Use of flywheels in machinesUse of flywheels for smoothing torque and speed, and for storing energy in vehicles, and in machines used for production processes |
| 8 | 3.11.1.5 Angular momentumAngular momentum = *Iω* Conservation of angular momentum. Angular impulse = change in angular momentum*T*Δ*t* = Δ(*Iω*) where *T* is constantApplications may include examples from sport |
| 9 | 3.11.1.6 Work and power *W* = *Tθ* *P* = *Tω* Awareness that frictional torque has to be taken into account in rotating machinery |
| 10 | *(Consolidation and exam questions practice)* |
| **CHAPTER 21 THERMODYNAMICS**(7 hours) |
| 1 | *(Revision of gas laws, ideal gas equation pV = nRT, absolute zero, kinetic theory model from Chapter 3)*  |
| 2 | 3.11.2.1 First law of thermodynamics Quantitative treatment of first law of thermodynamics: *Q* = Δ*U* + *W*where *Q* is energy transferred to the system by heating, Δ*U* is increase in internal energy and *W* is work done **by** the systemApplications of first law of thermodynamics |
| 3 | 3.11.2.2 Non-flow processesIsothermal, adiabatic, constant pressure and constant volume changes:*pV* = *nRT*adiabatic change *pVγ* = constantisothermal change *pV* = constantat constant pressure *W* = *p* Δ*V* Application of first law of thermodynamics to the above processes |
| 4 |
| 5 | 3.11.2.3 The *p*–*V* diagramRepresentation of processes on this diagramEstimation of work done in terms of area below the graphExtension to cyclic processes: work done per cycle = area of loopExpressions for work done are not required except for the constant pressure case, *W* = *p* Δ*V*  |
| 6 |
| 7 | *(Consolidation and exam questions practice)* |
| **CHAPTER 22 HEAT ENGINES**(8 hours) |
| 1 | 3.11.2.4 Engine cyclesUnderstanding of a four-stroke petrol engine cycle and a diesel engine cycle, and of the corresponding indicator diagramsA knowledge of engine constructional details is not requiredComparison with the theoretical diagrams for these cyclesQuestions may be set on other cycles, but they will be interpretative and all essential information will be given |
| 2 | 3.11.2.4 Engine cycles Input power = calorific value × fuel flow rate Indicated power as (area of *p*–*V* loop) × (no. of cycles per second) × (no. of cylinders)Output or brake power, *P* = *Tω* Friction power = indicated power – brake powerUse of indicator diagrams for predicting and measuring power |
| 3 |
| 4 | 3.11.2.4 Engine cycles Engine efficiency; overall, thermal and mechanical efficienciesOverall efficiency =  Thermal efficiency =  Mechanical efficiency = Use of indicator diagrams for predicting and measuring efficiency |
| 5 | 3.11.2.5 Second law and enginesImpossibility of an engine working only by the first law Second law of thermodynamics expressed as the need for a heat engine to operate between a source and a sinkEfficiency =  Maximum theoretical efficiency =  Reasons for the lower efficiencies of practical enginesMaximising use of *W* and *Q*H for example in combined heat and power schemes |
| 6 |
| 7 | 3.11.2.6 Reversed heat enginesBasic principles and uses of heat pumps and refrigeratorsA knowledge of practical heat pumps or refrigerator cycles and devices is not requiredCoefficients of performance:refrigerator: COPref =  heat pump: COPhp =  |
| 8 | *(Consolidation and exam questions practice)* |

Option Unit: Turning Points (25 hours)

| **One-hour lessons** | **Specification Content** |
| --- | --- |
| **CHAPTER 23 ELECTRONS** (7 hours) |
| 1  | 3.12.1.1 Cathode raysProduction of cathode rays in a discharge tube |
| 2  | 3.12.1.2 Thermionic emission of electronsThe principle of thermionic emissionWork done on an electron accelerated through a pd:  |
| 3  | 3.12.1.3 Specific charge of the electronDetermination of the specific charge of an electron, *e*/*m*e, by any one method *(crossed fields)*Significance of Thomson’s determination of *e*/*m*eComparison with the specific charge of the hydrogen ion |
| 4  | 3.12.1.3 Determination of the specific charge of an electron, *e*/*m*e, by any one method *(magnetic deflection)* |
| 5  | 3.12.1.4 Principle of Millikan’s determination of the electronic chargeCondition for holding a charged oil droplet, of charge *Q*, stationary between oppositely charged parallel plates: Motion of a falling oil droplet with and without an electric field; terminal speed to determine the mass and the charge of the dropletStokes’ law for the viscous force on an oil droplet used to calculate the droplet radius:*F* = 6π*ηrv*Significance of Millikan’s resultsQuantisation of electric charge |
| 6  |
| 7  | *(Consolidation and exam questions practice)* |
| **CHAPTER 24 WAVE PARTICLE DUALITY** (12 hours) |
| 1  |  3.12.2.1 Newton’s corpuscular theory of lightComparison with Huygens’ wave theory in general termsThe reasons why Newton’s theory was preferred. |
| 2  | 3.12.2.2 Significance of Young’s double slits experimentExplanation for fringes in general terms, no calculations are expectedDelayed acceptance of Huygens’ wave theory of light |
| 3  | 3.12.2.3 Electromagnetic wavesFizeau’s determination of the speed of light and its implications |
| 4  | 3.12.2.3 Nature of electromagnetic wavesMaxwell’s formula for the speed of electromagnetic waves in a vacuumwhere is the permeability of free space andis the permittivity of free spaceStudents should appreciate that relates to the electric field strength due to a charged object in free space and relates to the magnetic flux density due to a current-carrying wire in free space |
| 5  | 3.12.2.3 Hertz’s discovery of radio waves including measurements of the speed of radio waves |
| 6  | 3.12.2.4 The ultraviolet catastrophe and black-body radiationPlanck’s interpretation in terms of quanta |
| 7  | 3.12.2.4 the discovery of photoelectricityThe failure of classical wave theory to explain observations on photoelectricityEinstein’s explanation of photoelectricity and its significance in terms of the nature of electromagnetic radiation |
| 8  | 3.12.2.5 Wave–particle duality de Broglie’s hypothesis: *p* = *h/λ*Low-energy electron diffraction experiments; qualitative explanation of the effect of a change of electron speed on the diffraction pattern |
| 9  |
| 10  | 3.12.2.6 Electron microscopesEstimate of anode voltage needed to produce wavelengths of the order of the size of the atomPrinciple of operation of the transmission electron microscope (TEM) |
| 11  | 3.12.2.6 Principle of operation of the scanning tunnelling microscope (STM) |
| 12  | *(Consolidation and exam questions practice)* |
| **CHAPTER 25 SPECIAL RELATIVITY** (6 hours) |
| 1  | 3.12.3.1 The Michelson-Morley experimentPrinciple of the Michelson-Morley interferometerOutline of the experiment as a means of detecting absolute motionSignificance of the failure to detect absolute motionThe invariance of the speed of light |
| 2  | 3.12.3.2 Einstein’s theory of special relativityThe concept of an inertial frame of referenceThe two postulates of Einstein’s theory of special relativity:1 physical laws have the same form in all inertial frames2 the speed of light in free space is invariant3.12.3.3 Time dilationProper time and time dilation as a consequence of special relativityTime dilation: |
| 3  | 3.12.3.3 Time dilation:Evidence of time dilation from muon decay 3.12.3.4 Length contractionLength of an object having a speed : |
| 4  | 3.12.3.5 Mass and energyEquivalence of mass and energy, Graphs of variation of mass and kinetic energy with speed |
| 5  | 3.12.3.5 Bertozzi’s experiment as direct evidence for the variation of kinetic energy with speed |
| 6  | *(Consolidation and exam questions practice)* |

Option Unit: Electronics (25 hours)

|  |  |
| --- | --- |
| **One-hour lessons** | **Specification Content** |
| **CHAPTER 26 DISCRETE SEMICONDUCTOR DEVICES** (5 hours) |
| 1 | *(Review of semiconductor materials; charge carriers as electrons and holes; n- and p- type materials; the p-n junction)* |
| 2 | 3.13.1.1 MOSFET (metal-oxide semiconductor field-effect transistor)Use in N-channel, enhancement mode only is requiredSimplified structure, behaviour and characteristics Drain, source and gate *V*DS, *V*GS, *I*DSS and *V*thUse as a switch, use as a device with a very high input resistance |
| 3 | 3.13.1.2 Zener diodeCharacteristic curve showing Zener breakdown voltage and typical minimum operating currentAnode and cathodeUse with a resistor as a constant voltage source Use to provide a reference sourceUse as a stabiliser is not required  |
| 4 | 3.13.1.3 Photodiode Characteristic curves and spectral response curvesUse in photoconductive mode as a detector in optical systemsUse with scintillator to detect atomic particles |
| 5 | 3.13.1.4 Hall effect sensor*(The Hall effect)*Use as magnetic field sensor to monitor attitudeUse in tachometerPrinciples of operation are not required *(Consolidation and exam questions practice)* |
| **CHAPTER 27 ANALOGUE AND DIGITAL SIGNALS** (5 hours) |
| 1 | 3.13.2.1 Difference between analogue and digital signals*(Nature of analogue and digital signals)*Bits, bytesKnowledge of binary numbers 1 to 10The ability to carry out binary arithmetic is not requiredEffect of noise in communication systems Process of recovery of original data from noisy signal |
| 2 | 3.13.2.1 Students should appreciate the use of a variety of sensors to collect analogue dataAnalogue-to-digital conversion:- sampling audio signals for transmission in digital form - conversion of analogue signals into digital data using two voltage levels |
| 3 | 3.13.2.1 Analogue-to-digital conversion:- sampling rate - quantisation- effect of sampling rate and number of bits per sample on quality of conversion  |
| 4 | 3.13.2.1 Pulse code modulationAdvantages and disadvantages of digital sampling*(Consolidation and exam questions practice)* |
| 5 | 3.13.3.1 LC resonance filtersOnly parallel resonance arrangements are required*(Inductors and inductance)*Analogy between LC circuit and mass–spring systemInductance as mass analogyCapacitance as spring analogyResonant frequency,Energy (voltage) response curve*Q* factor,*f*B is the bandwidth at the 50% energy points*(Exam questions practice)* |
| **CHAPTER 28 OPERATIONAL AMPLIFIERS** (5 hours) |
| 1 | 3.13.3.2 The ideal operational amplifier The operational amplifier should be treated as an important system building block Operation and characteristics of an ideal operational amplifier:- power supply and signal connections- infinite open-loop gain- infinite input resistanceOpen-loop transfer function for a real operational amplifier, *V*out = *A*OL(*V*+ – *V*–)Use as a comparator |
| 2 | 3.13.4.1 Operational amplifier in inverting amplifier configurationDerivation of CalculationsMeaning of virtual earth, virtual-earth analysis3.13.4.2 Operational amplifier in non-inverting amplifier configurationDerivation is not required |
| 3 | 3.13.4.3 Operational amplifier in summing amplifier configurationDerivation is not required Difference amplifier configurationDerivation is not required  |
| 5 | 3.13.4.4 Real operational amplifiersLimitations of real operational amplifiersFrequency response curvegain × bandwidth = constant for a given device *(Consolidation and exam questions practice)* |
| **CHAPTER 29 DIGITAL SIGNAL PROCESSING** (5 hours) |
| 1 | 3.13.5.1 Combinatorial logic Use of Boolean algebra as related to truth tables and logic gates Identification of AND, NAND, OR, NOR NOT and EOR gatesThe gates should be treated as building blocks. The internal structure or circuit of the gates is not required |
| 2 | 3.13.5.1 Identification and use of AND, NAND, OR, NOR NOT and EOR gates in combination in logic circuitsConstruction and deduction of a logic circuit from a truth table |
| 3 | 3.13.5.2 Sequential logic*(The D-type flip- flop)*Counting circuits: binary counterInputs to the circuit, clock, reset, up/downOutputs from the circuit |
| 4 | 3.13.5.2 Counting circuits:- modulo-*n* counter from basic counter with the logic driving a reset pin - BCD counter- Johnson counterInputs to the circuits, clock, reset, up/downOutputs from the circuits |
| 5 | 3.13.5.3 Astables The astable as an oscillator to provide a clock pulseClock (pulse) rate (frequency), pulse width, period, duty cycle, mark-to-space ratioVariation of running frequency using an external *RC* network Knowledge of a particular circuit or a specific device (e.g. 555 chip) will not be required*(Consolidation and exam questions practice)* |
| **CHAPTER 30 DATA COMMUNICATIONS SYSTEMS** (5 hours) |
| 1 | 3.13.6.1 Principles of communication systemsCommunication systems, block diagram of ‘real time’ communication system Only the purpose of each stage is required3.13.6.2 Transmission media Transmission-path media: metal wire, optical fibre, electromagnetic (radio, microwave) |
| 2 | 3.13.6.2 *(Radio wave communication:)* ground waves, refraction and reflection of sky waves, diffraction of long-wavelength radiation around the Earth’s surfaceSatellite systems and typical transmission frequenciesStudents should recognise that up-links and down-links require different frequencies so that the receivers are not de-sensedAdvantages and disadvantages of various transmission media. Students should consider transmission rate, cost, and security issues |
| 3 | 3.13.6.4 Amplitude modulation (AM)and frequency modulation (FM) techniquesPrinciples of modulation; bandwidthDetails of modulation circuits for modulating a carrier signal with the information signal will not be requiredCarrier wave and information signalGraphical representation of both AM and FM modulated signalsStudents will be expected to identify the carrier frequency and the information frequency from a graph of the variation of signal voltage with timeBandwidth requirements of simple AM:bandwidth = 2*f*M Bandwidth requirements of simple FM:bandwidth = 2(Δ*f*  + *f*M)Data capacity of a channelComparison of bandwidth availability for various media |
| 4 |
| 5 | 3.13.6.3 Time-division multiplexingBasic principles of time-division multiplexing*(Consolidation and exam questions practice)* |