RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics and Communication Engineering
COURSE: EC-701 Optical Communication

Category of course	Course Title	Course code	Credit-4C			Theory paper (ES)
Departmental Core (DC-17)	Optical communication	EC-701	L 3	T 1	P 2	Max. Marks-100 Min. Marks: 35 Duration: 3 hrs.

Course Contents

Unit-I

Overview of Optical Fiber Communications (OFC): Motivation, optical spectral bands, key elements of optical fiber systems.

Optical fibers: basic optical laws and definitions, optical fiber modes and configurations, mode theory for circular waveguides, single-mode fibers, graded-index fiber structure, fiber materials, photonic crystal fibers, fiber fabrication, fiber optic cables.

Unit-II

Optical sources: Light emitting diodes (LEDs): structures, materials, quantum efficiency, LED power, modulation of an LED. Laser diodes: modes, threshold conditions, laser diode rate equations, external quantum efficiency, resonant frequencies, structure and radiation patterns, single mode lasers, modulation of laser diodes.

Power launching and coupling: source to fiber power launching, fiber to fiber joints, LED coupling to single mode fibers, fiber splicing, optical fiber connectors.

Unit-III

Photodetectors: pin photodetector, avalanche photodiodes, photodetector noise, detector response time, avalanche multiplication noise.

Signal degradation in optical fibers: Attenuation: units, absorption, scattering losses, bending losses, core and cladding losses. Signal distortion in fibers: overview of distortion origins, modal delay, factors contributing to delay, group delay, material dispersion, waveguide dispersion, polarization-mode dispersion. Characteristics of single mode fibers: refractive index profiles, cutoff wavelength, dispersion calculations, mode field diameter, bending loss calculation. Specialty fibers.

Unit-IV

Optical receivers: fundamental receiver operation, digital receiver performance, eye diagrams, coherent detection: homodyne and heterodyne, burst mode receiver, analog receivers.

Digital links: point to point links, link power budget, rise time budget, power penalties.

Analog links: overview of analog links, carrier to noise ratio, multichannel transmission techniques.

Unit-V

Optical technologies

Wavelength division multiplexing (WDM) concepts: operational principles of WDM, passive optical star coupler, isolators, circulators, Active optical components: MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, polarization controller, chromatic dispersion compensators.

Optical amplifiers: basic applications and types of optical amplifiers, Erbium Doped Fiber Amplifiers (EDFA): amplification mechanism, architecture, power conversion efficiency and gain. Amplifier noise, optical SNR, system applications.

Performance Measurement and monitoring: measurement standards, basic test equipment, optical power measurements, optical fiber characterization, eye diagram tests, optical time-domain reflectometer, optical performance monitoring.

References:

1. G. Keiser: Optical Fiber Communications, 4th Edition, TMH New Delhi.
2. J. M. Senior: Optical Fiber Communication- Principles and Practices, 2nd Edition, Pearson Education.
3. G. P. Agarwal: Fiber Optic Communication Systems, 3rd Edition, Wiley India Pvt. Ltd.
4. J. C. Palais: Fiber Optics Communications,5th Edition, Pearson Education.
5. R.P. Khare: Fiber Optics and Optoelectronics, Oxford University Press.
6. A. Ghatak and K. Thyagrajan: Fiber Optics and Lasers, Macmillan India Ltd.
7. S. C. Gupta: Optoelectronic Devices and Systems, PHI Learning.
8. Sterling: Introduction to Fiber Optics, Cengage Learning.

List of Experiments:

1. Launching of light into the optical fiber and calculate the numerical aperture and V-number.
2. Observing Holograms and their study.
3. Optic version Mach-Zehnder interferometer.
4. Measurement of attenuation loss in an optical fiber.
5. Diffraction using gratings.
6. Construction of Michelson interferometer.
7. Setting up a fiber optic analog link and study of PAM.
8. Setting up a fiber optic digital link and study of TDM and Manchester coding.
9. Measurement of various misalignment losses in an optical fiber.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics and Communication Engineering
COURSE: EC-702 Antenna and Wave Propagation

Category of course	Course Title	Course code	Credit-6C			Theory paper (ES)
Departmental Core (DC-18)	Antenna and Wave Propagation	EC-702	L	T	P	Max. Marks-100 Min. Marks: 35 Duration: 3 hrs.
			3	1	2	

Course Contents

Unit I

Introduction to antenna: antenna terminology, radiation, retarded potential, radiation field from current element, radiation resistance of short dipole and half wave dipole antenna, network theorems applied to antenna, self and mutual impedance of antenna, effect of earth on vertical pattern and image antenna.

Unit II

Antenna arrays: of point sources, two element array, end fire and broad side arrays, uniform linear arrays of n-elements, linear arrays with non-uniform amplitude distribution (binomial distribution and Chebyshev optimum distribution), arrays of two-driven half wave length elements (broad side and end fire case), principle of pattern multiplication.

Unit III

Types of antennas: Babinet's principles and complementary antenna, horn antenna, parabolic reflector antenna, slot antenna,log periodic antenna, loop antenna, helical antenna, biconical antenna, folded dipole antenna, Yagi-Uda antenna, lens antenna, turnstile antenna. Long wire antenna: resonant and travelling wave antennas for different wave lengths, V-antenna, rhombic antenna, beverage antenna, microstrip antenna.

Unit IV

Antenna array synthesis: introduction, continuous sources, methods-Schelknoff polynomial method, Fourier transform method, Woodward- Lawson method, Taylor's method, Laplace transform method, Dolph- Chebychev method, triangular, cosine and cosine squared amplitude distribution, line source, phase distribution, continuous aperture sources.

Unit V

Propagation of radio wave: structure of troposphere, stratosphere and ionosphere, modes of propagation, ground wave propagation, duct propagation. Sky wave propagation: Mechanism of Radio Wave Bending by Ionosphere, critical angle and critical frequency, virtual height, skip distance and LUF, MUF. Single hop and multiple hop transmission, influence of earths magnetic field on radio wave propagation, Fading Space Wave Propagation: LOS, effective earth's radius, field strength of space or tropospheric propagation.

References:

1. J. D. Krauss: Antennas;for all applications, TMH.
2. R. E. Collin, Antennas and Wave Propagation, Wiley India Pvt. Ltd.
3. C. A. Balanis: Antenna Theory Analysis and Design, Wiley India Pvt. Ltd.
4. Jordan and Balmain: Electromagnetic Fields and Radiating System, PHI.
5. A. R. Harish and M. Sachidananda: Antennas and wave propagation, Oxford University Press.
6. K. D. Prasad: Antennas and Wave Propagation, Satya Prakashan.
7. B. L. Smith: Mordern Anteenas, 2nd Edition, Springer, Macmillan India Ltd.

List of Experiments:

Following illustrative practical should be simulated with the help of any RF simulation software e.g. FEKO / HFSS / IE3D / Microwave Office / Microwave Studio or any other similar software:-

1. To Plot the Radiation Pattern of an Omni Directional Antenna.
2. To Plot the Radiation Pattern of a Directional Antenna.
3. To Plot the Radiation Pattern of a Parabolic Reflector Antenna.
4. To Plot the Radiation Pattern of a Log Periodic Antenna.
5. To Plot the Radiation Pattern of a Patch Antenna.
6. To Plot the Radiation Pattern of a Dipole/ Folded Dipole Antenna.
7. To Plot the Radiation Pattern of a Yagi (3-EL/4EL) Antenna.
8. To Plot the Radiation Pattern of a Monopole/ WHIP/ Collinear Antenna.
9. To Plot the Radiation Pattern of a Broad site Antenna.
10. To Plot the Radiation Pattern of a Square Loop Antenna.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics & Communication Engineering
COURSE: EC-703 TV and Radar Engineering

Category of course	Course Title	Course code	Credit-6C			Theory paper (ES)
Departmental Core (DC-19)	TV and Radar Engineering	EC-703	L	T	P	Max. Marks-100 Min. Marks: 35 Duration: 3 hrs.
			3	1	2	

Course Contents

Unit I
Basic Television System
Introduction: Scanning principles: sound and picture transmission, scanning process, camera pick-up devices, video signal, transmission and reception of video signals, brightness perception and photometric quantities, aspect ratio and rectangular scanning, persistence of vision and flicker, vertical resolution, the Kell factor, horizontal resolution and video bandwidth, interlaced scanning.
Composite Video Signal: Lines and scanning, video signal components, horizontal sync and blanking standards, vertical sync and blanking standards, video modulation and vestigial side band signal, sound modulation and inter-carrier system.
Television Standards: Standard channel characteristics, reception of the vestigial side band signals, television broadcast channel, consolidated CCIR system-B standard, various television broadcast systems.
Television Pick-up devices and Cameras: Camera lenses, auto-focus systems, television camera pick-ups, Silicon Vidicon, CCD image sensors, video processing of camera pick-up signal.

Unit II
Colour Television
Colour fundamentals: mixing of colours and colour perception, chromaticity diagram, colour television camera, colour TV signals and transmission, NTSC, SECAM and PAL system, Trinitron picture tube, automatic degaussing, plasma, LCD displays.
Television transmission and reception: requirement of TV broadcast transmission, design principle of TV transmitters, IF modulation, power output stages, block diagram of TV transmitter, co-channel interference and ghost images during propagation of television signals, antenna requirements for television system, block schematic and function requirements for television receivers, trends in circuit design, colour television receiver.

Unit III
Digital Television Technology
Merits of digital technology, fully digital television system, digital television signals, digitized video parameters, digital video hardware, transmission of digital TV signals, bit rate reduction, digital TV receivers, video processor unit, audio processor unit.
Other television systems: Closed Circuit television system (CCTV), Cable television system (CATV), multiplexed analog component encoding television system (MAC TV), High definition television system (HDTV), High definition multiplexed analog component television (HD-MAC TV), High Performance Computer Controlled TV (HPCC TV), 3-D stereoscopic television techniques..

Unit IV
RADAR
The Radar range equation, block diagram and operation, performance factors: prediction of range performance, minimum detectable signal, receiver noise, probability density functions, signal to noise ratios. Radar cross section of targets, transmitter power, pulse repetition frequency and range ambiguities, antenna parameters.
The CW radar: the Doppler effect, FM-CW radar.
The Moving Target Indicator (MTI) Radar: delay line cancellers.

Unit V
Radar Receivers
The radar receiver, noise figure, mixers, low noise front ends, displays- type A and PPI representations, duplexer and receiver protectors.
Other Radar systems: Synthetic aperture radar, HF over the horizon radar, Air Surveillance Radar (ASR), Bistatic radar.

References:

1. M. Dhake: Television and Video Engineering, 2nd Edition,TMH, New Delhi.
2. M. I. Skolnik: Introduction to Radar Systems, TMH, New Delhi.
3. R. G. Gupta: Television Engineering and Video Systems, TMH, New Delhi.
4. R. R. Gulati: Monochrome and Colour Television, New Age International.
5. Grob and Herndon: Basic Television and Video Systems, McGraw Hill International.
6. P. Z. Peebles, Jr.: Radar Principles, Wiley India Pvt. LTD.
7. Edde: Radar- Principles, Technology Applications, Pearson Education.

List of Experiments:

Section A: Television Engg.

1. (a) To Study the Circuit Description of RF Tuner Section.
   (b) To Study the RF Section by Measuring Voltages at Various Test Points.
   (c) To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for RF Section.
2. (a) To Study the Circuit Description of VIF Tuner Section.
   (b) To Study the VIF Section by Measuring Voltages at Various Test Points.
   (c) To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for VIF Section.
3. (a) To Study the Circuit Description of Video and Chroma Section Tuner Section.
   (b) To Study the Video and Chroma Section by Measuring Voltages at Various Test Points
   (c) To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for Video and Chroma Section.
4. (a) To Observe the Horizontal Oscillator and Horizontal Output Section through Various Test Point.
   (b) To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for Horizontal Oscillator and Horizontal Output Section.
5. (a) To Observe the Vertical Oscillator and Vertical Output Section through Various Test Point.
   (b) To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for Vertical Oscillator and Vertical Output Section.
6. To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for Sound Output Section.
7. To Study the Circuit Description of Audio and Video Section Tuner Section.
8. (a) To Study the System Control Section by Measuring Voltages at Various Test Points.
   (b) To Study the Fault Simulation and Step-by-Step Fault Finding Procedure for System Control Section.

Section B: RADAR

1. Study of Doppler Effect.
2. To Measure Speed of a fan and various Other Objects (Pendulum, Tuning Fork, Plate etc.)
3. To Simulate the Variable Speed of Moving Objects using Velocity Simulator.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics & Communication Engineering
COURSE: EC-7101 Wireless Communications

Category of course	Course Title	Course code	Credit-6C			Theory paper (ES)
DCO(E)-I	Wireless Communications	EC-7101	L	T	P	Max. Marks-100
			3	1	0	Min. Marks: 35 Duration: 3 hrs.

Course Contents

Unit-I

Introduction

Applications and requirements of wireless services: history, types of services, requirements for the services, economic and social aspects.

Technical challenges in wireless communications: multipath propagation, spectrum limitations, limited energy, user mobility, noise and interference-limited systems.

Propagation mechanism: free space loss, reflection and transmission, diffraction, scattering by rough surfaces, waveguiding.

Unit-II

Wireless Propagation channels

Statistical description of the wireless channel: time invariant and variant two path models, small-scale fading with and without a dominant component, Doppler spectra, temporal dependence of fading, large scale fading.

Wideband and directional channel characteristics: causes of delay dispersion, system theoretic description of wireless channels, WSSUS model, condensed parameters, ultrawideband channels, directional description.

Unit-III

Channel models: Narrowband, wideband and directional models, deterministic channel-modelling methods.

Channel sounding: Introduction, time domain measurements, frequency domain analysis, modified measurement methods, directionally resolved measurements.

Antennas: Introduction, antennas for mobile stations, antennas for base stations.

Unit-IV

Transceivers and signal processing: Structure of a wireless communication link: transceiver block structure, simplified models. Modulation formats, demodulator structure, error probability in AWGN channels, error probability in flat-fading channels, error probability in delay and frequency-dispersive fading channels.

Unit V

Diversity: Introduction, microdiversity, macrodiversity and simulcast, combination of signals, error probability in fading channels with diversity reception, transmit diversity.

Equalizers: Introduction, linear equalizers, decision feedback equalizers, maximum likelihood sequence estimation (Viterbi detector), comparison of equalizer structures, fractional spaced equalizers, blind equalizers.

References:

1. A. F. Molisch: Wireless Communications, Wiley India Pvt. Ltd.
2. Taub and Schilling: Principles of Communication Systems, TMH.
3. Upena Dalal: Wireless Communication, Oxford University Press.
4. T. G. Palanivelu and R. Nakkereeran : Wireless and Mobile Communication, PHI Learning.
5. P. M. Chidambara Nathan: Wireless Communication, PHI Learning.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics & Communication Engineering
COURSE: EC-7102 Digital Image Processing

Category of course	Course Title	Course code	Credit-6C			Theory paper (ES)
DCO(E)-I	Digital Image Processing	EC-7102	L	T	P	Max. Marks-100 Min. Marks: 35 Duration: 3 hrs.
			3	1	0	

Course Contents

Unit-I
Digital Image Processing (DIP)
Introduction, examples of fields that use DIP, fundamental Steps in DIP, components of an image processing System.
Digital Image Fundamentals: elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels.

Unit-II
Image Transforms
Two-dimensional (2-D) impulse and its shifting properties, 2-D continuous Fourier Transform pair, 2-D sampling and sampling theorem, 2-D Discrete Fourier Transform (DFT), properties of 2-D DFT.
Other transforms and their properties: Cosine transform, Sine transform, Walsh transform, Hadamard transform, Haar transform, Slant transform, KL transform.

Unit-III
Image Enhancement
Spatial domain methods: basic intensity transformation functions, fundamentals of spatial filtering, smoothing spatial filters (linear and non-linear), sharpening spatial filters (unsharp masking and highboost filters), combined spatial enhancement method.
Frequency domain methods: basics of filtering in frequency domain, image smoothing filters (Butterworth and Guassian low pass filters), image sharpening filters (Butterworth and Guassian high pass filters), selective filtering.

Unit-IV
Image Restoration
Image degradation/restoration, noise models, restoration by spatial filtering, noise reduction by frequency domain filtering, linear position invariant degradations, estimation of degradation function, inverse filtering, Wiener filtering, image reconstruction from projection.

Unit-V
Image Compression
Fundamentals of data compression: basic compression methods: Huffman coding, Golomb coding, LZW coding, Run-Length coding, Symbol based coding.
Digital Image Watermarking, Representation and Description- minimum perimeter polygons algorithm (MPP).

References:

1. R. C. Gonzalez and R. E. Woods: Digital Image Processing, 3rd Edition, Pearson Education.
2. A. K. Jain: Fundamentals of Digital Image Processing, PHI Learning.
3. S. Annadurai and R. Shanmugalakshmi: Fundamentals of Digital Image Processing, Pearson Education.
4. M. Sonka, V. Hlavac and R. Boyle: Digital Image Processing and Computer Vision: Cengage Learning.
5. B. Chanda and D. D. Majumder: Digital Image Processing and Analysis, PHI Learning.
6. S. Jayaraman, S. Esakkirajan and T. Veerakumar: Digital Image Processing, TMH.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics & Communication Engineering
COURSE: EC-7103 Industrial Electronics

<table>
<tr><th>Category of course</th><th>Course Title</th><th>Course code</th><th colspan="3">Credit-6C</th><th>Theory paper (ES)</th></tr>
<tr><td rowspan="2">DCO(E)-I</td><td rowspan="2">Industrial Electronics</td><td rowspan="2">EC- 7103</td><td>L</td><td>T</td><td>P</td><td rowspan="2">Max. Marks-100
Min. Marks: 35
Duration: 3 hrs.</td></tr>
<tr><td>3</td><td>1</td><td>0</td></tr>
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Course Contents

Unit I
Rectifiers
Uncontrolled, Half-Controlled and Fully Controlled Single-Phase and Three-Phase Rectifiers for Resistive and Resistive-Inductive Load, Use of Free-Wheel Diode, Dual Converter, Input and Output Performance Parameters, Heat Sink.

Unit II
AC Voltage Regulators and Cyclo-converters
Principle of On-Off Control and Phase Control, Single-Phase Voltage Controller for Resistive and Resistive-Inductive Load, Sequence Control of AC Voltage Controller, Three-Phase Voltage Regulator. Principle of Cyclo-converter, Single-Phase to Single-Phase Step-up and Step-Down Cyclo-Converter, Three-Phase to Single-Phase and Three-Phase to Three-Phase Cyclo-Converter.

Unit III
Inverters
Single-Phase Bridge Inverter, Three-Phase Inverters-180^o and 120^o Conduction Mode, Voltage Control of Single-Phase Inverters-Single, Multiple, Sinusoidal, Modified Sinusoidal Pulse-Width Modulation, Advanced Modulation Techniques- Trapezoidal, Staircase, Stepped, Harmonic Injection and Delta Modulation. Induction Motor AC Drives.

Unit IV
Chopper
Principle of Step-Down and Step-Up Chopper, Converter Classification, Multi-Phase Chopper, Switching-Mode Regulators-Buck, Boost, Buck-Boost and Cuk Regulators, DC Drives.

Unit V
Residential and Industrial Application
Space Heating and Air Conditioner, High Frequency Fluorescent Lighting, Electronic Timer, Battery Charger, Switch-Mode-Power-Supply (SMPS), Uninterruptible Power Supply (UPS), Static Switches, Induction Heating, Electric Welding, Introduction of HVDC and FACTs.

References:

1. Mohan, Undeland and Robbins: Power Electronics, Wiley-India Edition.
2. M. H. Rashid: Power Electronics- Circuits, Devices and Applications, Pearson Education.
3. P. S. Bimbhra: Power Electronics, Khanna Publisher.
4. Alok Jain: Power Electronics and Its Application, Penram International.
5. Biswanath Paul: Industrial Electronics, PHI Learning.
6. T. E. Kissell : Industrial Electronics, PHI Learning.

COURSE: EC-7201 Satellite Communication

Category of course	Course Title	Course code	Credit-4C			Theory paper (ES)
DCO(E)-II	Satellite communication	EC-7201	L 3	T 1	P 0	Max. Marks-100Min. Marks: 35 Duration: 3 hrs.

Course Contents

Unit-I

Overview of satellite systems: Introduction, Frequency allocations for satellite systems.

Orbits and launching methods: Kepler's three laws of planetary motion, terms used for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, local mean solar point and sun-synchronous orbits, standard time.

Unit-II

The Geostationary orbit: Introduction, antenna look angles, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite, sun transit outage, launching orbits.

Polarization: antenna polarization, polarization of satellite signals, cross polarization discrimination.

Depolarization: ionospheric, rain, ice.

Unit-III

The Space segment: introduction, power supply, attitude control, station keeping, thermal control, TT&C subsystem, transponders, antenna subsystem, Morelos and Satmex 5, Anik-satellites, Advanced Tiros-N spacecraft.

The Earth segment: introduction, receive-only home TV systems, master antenna TV system, Community antenna TV system, transmit-receive earth station.

Unit-IV

The space link: Introduction, Equivalent isotropic radiated power (EIPR), transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, intermodulation noise, inter-satellite links.

Interference between satellite circuits.

Unit-V

Satellite services

VSAT (very small aperture terminal) systems: overview, network architecture, access control protocols, basic techniques, VSAT earth station, calculation of link margins for a VSAT star network.

Direct broadcast satellite (DBS) Television and radio: digital DBS TV, BDS TV system design and link budget, error control in digital DBS-TV, installation of DBS-TV antennas, satellite radio broadcasting.

References:

1. D. Roddy: Satellite Communications, 4th Edition, TMH, New Delhi.
2. T. Pratt, C. Bostian and J. Allnut: Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd.
3. W. L. Pritchard, H. G. Suyderhoud and R. A. Nelson: Satellite Communication Systems Engineering, 2nd Edition, Pearson Education.
4. D.C. Agarwal: Satellite Communications, Khanna Publishers.
5. R. M. Gangliardi: Satellite Communications, CBS Publishers.
6. M. R. Chartrand: Satellite Communication, Cengage Learning.
7. Raja Rao: Fundamentals of Satellite communications, PHI Learning.
8. Monojit Mitra: Satellite Communication: PHI Learning.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics & Communication Engineering
COURSE: EC-7202 Neural Networks

Category of course	Course Title	Course code	Credit-6C			Theory paper (ES)
DCO(E)-II	Neural Networks	EC-7202	L	T	P	Max. Marks-100 Min. Marks: 35 Duration: 3 hrs.
			3	1	0	

Course Contents

Unit-I
Neural Network (NN)
Introduction, benefits of neural network, models of a neuron, neural network as directed graph, network architectures, artificial intelligence and neural network.
Learning processes: error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzman learning, learning tasks, adaptation, statistical nature of learning process, statistical learning theory.

Unit-II
Perceptrons
Single layer perceptrons: adaptive filtering problem, unconstrained optimization technique, linear least squares filter, least mean square algorithm (LMS), perceptron convergence theorem
Multi layer perceptron: architecture, back propagation algorithm, generalization, approximations of functions, network pruning techniques.

Unit-III
Radial Basis Function (RBF) Networks
Cover's theorem on the separability of patterns, interpolation problem, supervised learning as an Ill-posed hypersurface reconstruction problem, regularization theory, regularization network, generalized radial basis function networks (RBF), estimation of the regularization parameter, approximation properties of RBF networks, comparison of RBF networks and multilayer perceptrons, Kernel regression and its relation to RBF networks, learning strategies.

Unit-IV
Information- Theoretic Models
Entropy, maximum entropy principle, mutual information, Kullback-Leibler divergence, mutual information as an objective function to be optimized, maximum mutual information principle, infomax and redundancy reduction, spatially coherent and incoherent features, independent components analysis, maximum likelihood estimation, maximum entropy method.

Unit V
Dynamically Driven Recurrent Networks
introduction, recurrent network architectures, state space model, non-linear autogressive with exogenous inputs model, computational power of recurrent networks, learning algorithms, back propagation through time, real time recurrent learning, Kalman filter, decoupled Kalman filter, vanishing gradients in recurrent networks, system identification, model reference adaptive control.

References:

1. S. Haykin: Neural Networks- A Comprehensive Foundation, PHI Learning.
2. S. N. Sivanandam, S. Sumathi and S. N. Deepa: Introduction to Neural Networks using Matlab 6.0, TMH, New Delhi.
3. J. A Freeman and D. M. Skapura: Fundamentals of Neural Networks- algorithms, applications and programming techniques, Pearson Education.
4. M. T. Hagan, H. B. Demuth and M. Beale: Neural Network Design, Cengage Learning.
5. J.A Anderson: An introduction ro Neural Networks, PHI Learning.
6. Satish Kumar: Neural Networks, TMH, New Delhi.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL
PROGRAMME: Electronics and Communication Engineering
COURSE: EC-7203 Random Signal Theory

Category of course	Course Title	Course code	Credit-4C			Theory paper (ES)
DCO(E)-II	Random Signal Theory	EC-7203	L 3	T 1	P 0	Max. Marks-100 Min. Marks: 35 Duration: 3 hrs.

Course Contents

Unit-I
Introduction: Random input signals, random disturbances, random system characteristics, random experiments and events.
Random variables: Concept of random variable, distribution functions, density functions, mean values and moments, the Guassian random variable, density functions related to guassian- Rayleigh distribution, Maxwell distribution, Chi-square distribution, log normal distribution. Other distribution functions-uniform distribution, exponential distribution, delta distribution. Conditional probability distribution and density functions.

Unit-II
Several random variables: Two random variables, joint conditional probability, statistical independence, correlation between random variables, density function of the sum of two random variables, probability density function of a function of two random variables, the characteristic function.
Elements of statistics: Sampling theory- the sample mean, the sample variance, sampling distributions and confidence interval, hypothesis testing, curve fitting and linear regression, correlation between two sets of data.

Unit-III
Random Processes: Continuous and discrete, deterministic and nondeterministic, stationary and nonstationary, ergodic and nonergodic.
Correlation functions: Introduction, autocorrelation function of a binary process, properties of auto correlation functions, examples of autocorrelation functions, crosscorrelation functions, properties of crosscorrelation functions, examples and applications of crosscorrelation functions, correlation matrices for sampled functions.

Unit-IV
Spectral Density: Introduction, relation of spectral density to the fourier transform, properties of spectral density, spectral density and the complex frequency plane, mean square values from spectral density, relation of spectral density to the autocorrelation function, white noise, cross spectral density, examples and applications of spectral density,

Unit-V
Response of linear systems to random input: Analysis in the time domain, mean and mean square value of system output, autocorrelation function of system output, crosscorrelation between input and output, spectral density at the system output.
Optimum linear systems: Criteria of optimality, restrictions on the optimum system, optimization by parameter adjustment, systems that maximize signal-to-noise ratio, systems that minimize mean square error.

References:

1. G. R. Cooper and C. D. Mcgillem: Probabilistic Methods of Signal and System Analysis, Third Edition, Oxford University Press.
2. M. Lefebvre: Applied Probability and Statistics, Springer, Macmillan India Limited.
3. A. Papoulis, S. U. Pillai: Probability, Random Variable and Stochastic Processes, TMH.

COURSE: EC-704 Major Project (Planning and Literature Survey)

Category of course	Course Title	Course code	Credit-4C			Practical Exam
DC-20	Major Project (Planning and Literature Survey)	EC-704	L 0	T 0	P 4	Nil

Course Contents

The Major Project Work provides students an opportunity to do something on their own and under the supervision of a guide. Each student shall work on an approved project, which should be selected from some real life problem as far as possible, which may involve fabrication, design or investigation of a technical problem. The project work involves sufficient work so that students get acquainted with different aspects of manufacturing, design or analysis. The student also have to keep in mind that in final semester they would be required to implement whatever has been planned in the major project in this semester. It is possible that a work, which involves greater efforts and time, may be taken up at this stage and finally completed in final semester, but partial completion report should be submitted in this semester and also evaluated internally. At the end of semester, all students are required to submit a synopsis.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

PROGRAMME: Electronics and Communication Engineering
COURSE: EC-705 Industrial Training

Category of course	Course Title	Course code	Credit-4C			Theory paper (ES)
DC-21	Industrial Training	EC-705	L 0	T 0	P 0	Max. Marks-50 Min. Marks: 25 Duration: 3 hrs.

Course Contents

Duration: 6 weeks after the VI semester in the summer break. Assessment in VII semester.

SCHEME OF EXAMINATION

For the assessment of industrial training undertaken by the students, following components are considered with respective weightage.

(A)	**Term work In Industry**	**Marks allotted**
1.	Attendance and General Discipline	05
2.	Daily diary Maintenance	05
3.	Initiative and Participative attitude during training	05
4.	Assessment of training by Industrial Supervisor/s	15
	Total	**30**

(B)	**Practical/Oral Examination (Viva-voce In Institution**	**Marks allotted**
1.	Training Report	20
2.	Seminar and cross questioning (defense)	30
	Total	**50**

Marks of various components in industry should be awarded to the student, in consultation with the Training and Placement Officer (TPO)/ Faculty of the institute, who must establish contact with the supervisor/ authorities of the organization where, students have taken training, to award the marks for term work. During training, students will prepare a first draft of the training report in consultation with the section incharge. After training they will prepare final draft with the help of the TPO/ faculty of the institute. Then, they will present a seminar on their training and will face viva-voce on training in the institute.