SCHEME & SYLLABUS

for

M.TECH. COURSE

in

SIGNAL PROCESSING

(w.e.f. Session 2018-2019)

DEPARTMENT OF ELECTRONICS ENGINEERING

J.C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

J.C.BOSE UNIVERSITY OF SCIENCE & TECHNOLOGY, YMCA, FARIDABAD

VISION

J. C. Bose University of Science & Technology, YMCA, Faridabad (erstwhile YMCA University of Science and Technology) aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Department of Electronics Engineering

VISION

To be a Centre of Excellence for producing high quality engineers and scientists capable of providing sustainable solutions to complex problems and promoting cost effective indigenous technology in the area of Electronics, Communication & Control Engineering for Industry, Research Organizations, Academia and all sections of society.

MISSION

- To frame a well-balanced curriculum with an emphasis on basic theoretical knowledge as well the requirements of the industry.
- To motivate students to develop innovative solutions to the existing problems for betterment of the society.
- Collaboration with the industry, research establishments and other academic institutions to bolster the research and development activities.
- To provide infrastructure and financial support for culmination of novel ideas into useful prototypes.
- To promote research in emerging and interdisciplinary areas and act as a facilitator for knowledge generation and dissemination through Research, Institute - Industry and Institute-Institute interaction.

About Electronics Engineering Department

J. C. Bose University of Science & Technology, Faridabad (erstwhile YMCA University of Science & Technology, Faridabad) established in 2009, formerly known as YMCA Institute of Engineering, Faridabad, established in year 1969 as a Joint Venture of Govt. of Haryana and National Council of YMCA of India with active assistance from overseas agencies of West Germany to produce highly practical oriented personnel in specialized field of engineering to meet specific technical manpower requirement of industries. Electronics Engineering Department started in 1969 and has been conducting B.Tech. Courses in Electronics Instrumentation and Control and Electronics and Communication Engineering of 4-Years duration since 1997. Students are admitted through centralized counseling nominated by state govt. in 1^{st} Year and 2^{nd} year through lateral entry entrance test. Besides under graduate degree courses, it is also running M.Tech. Courses in VLSI, Instrumentation and Electronics & Communication. Department of Electronics Engineering is also running Ph.D. Programme. All courses are duly approved by AICTE/ UGC. The Electronics Engineering Department has been well known for its track record of employment of the pass out students since its inception.

The Department has good infrastructure consisting of 11 laboratories, 10 Lecture Halls and 1 Conference Room beside 6 workshops. It has excellent faculty with 2 Professors, 2 Associate Professors and 21 Assistant Professors. At present, 6 faculty members are PhD in various specializations. The various syllabi of UG/PG courses have been prepared with active participation from Industry. The Department is organizing number of expert lectures from industry experts for students in every semester. During the project/dissertation work emphasis has been given on skill enhancement of students. Choice based system allows students to study the subjects of his/her choice from a number of elective courses /audit courses.

Program Educational Objectives (PEO):

Students of the Master of Technology programs in Signal Processing will demonstrate

1. Employability in the diversified sectors of the core industry, public sector or multinational corporations in the domain of semiconductor, microelectronics, wireless communication, optical and satellite communication, networking etc. and/or pursue higher education in technologies related to communication and networking platforms at institutes of high repute.
2. To provide technical skills in software and hardware tools related to the design and implementation of Communication and signal processing Systems
3. To inculcate research culture in the learners of the program with abilities to publish at national/international level and develop prototype technologies in the related domain.
4. Attitude of lifelong learning and skills of effective inter-person communication resulting in leading diverse teams, with ethical and social behavior.

Program Outcomes (PO):

1. Ability to acquire and apply in-depth knowledge in the area of Electronics and Communication Engineering and contribute to the state-of-art.
2. An ability to independently carry out research /investigation and development work to solve practical problems
3. An ability to write and present a substantial technical report/document
4. An Ability to engage in life-long learning and learning through mistakes with / without external feedback.
5. An ability to understand the role of a leader, leadership principles and attitude conducive to effective professional practice of Electronics and Communication Engineering
6. An ability to understand the impact of research and responsibility in order to contribute to the society.

GRADING SCHEME

Marks %	**Grade**	**Grade points**	**Category**
90-100	O	10	Outstanding
80 ≤ marks <90	A+	9	Excellent
70 ≤ marks < 80	A	8	Very good
60 ≤ marks < 70	B+	7	Good
50 ≤ marks < 60	B	6	Above average
45 ≤ marks < 50	C	5	Average
40 ≤ marks < 45	P	4	Pass
<40	F	0	Fail
	Ab	0	Absent

Percentage calculation= CGPA * 9.5

M. TECH. (SIGNAL PROCESSING)

Total Credits	**68**
Total Theory Subjects	**11+2 Audits**
Total Labs (including Projects)	**5**
Total Dissertation	**2**

SEMESTER WISE SUMMARY OF THE PROGRAMME: M.TECH. (SP)

S.No.	Semester	No. of Contact Hours	Marks	Credits
1	I	24	700	18
2	II	26	650	18
3	III	26	500	16
4	IV	32	500	16
Total		108	2350	68*

NOTE:

***It is mandatory to pass the MOOC course(s) by all the students as per implementation of credit transfer/ mobility policy of on line courses of the University-as mentioned in Annexure-A at the end of the syllabus.**

Semester I

M. Tech. (Signal Processing)

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	MSP101	Advanced Digital Signal Processing	3	0	0	3	25	75	100
2	PCC	MSP102	Digital Image and Video Processing	3	0	0	3	25	75	100
3	PEC		Program Specific Elective-I	3	0	0	3	25	75	100
4	PEC		Program Specific Elective-II	3	0	0	3	25	75	100
5	PCC	RMI101	Research Methodology and IPR	2	0	0	2	25	75	100
6	AUD		Audit course 1	2	0	0	0	25	75	100
7	PCC	MSP151	Advanced Digital Signal Processing Lab	0	0	4	2	15	35	50
8	PCC	MSP152	Digital Image and Video Processing Lab	0	0	4	2	15	35	50
			Total Credits				**18**	180	520	700

	Course Name	Course Title
Program Elective-I	MSPE101	DSP Architecture
	MSPE102	Computer Vision
	MSPE103	Remote Sensing
Program Elective-II	MSPE104	JTFA and MRA
	MSPE105	Voice and Data Networks
	MSPE106	Audio Video Coding & Compression

AUD 1	**AUD01A**	English for Research Paper Writing
	AUD02A	Disaster Management
	AUD03A	Sanskrit for Technical Knowledge
	AUD04A	Value Education
	AUD05A	Constitution of India
	AUD06A	Pedagogy Studies
	AUD07A	Stress Management by Yoga
	AUD08A	Personality Development through Life Enlightenment Skills.
	AUD09A	Vivekananda Thoughts

Semester II

M. Tech. (Signal Processing)

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	MSP201	Pattern Recognition and Machine Learning	3	0	0	3	25	75	100
2	PCC	MSP202	Detection and Estimation Theory	3	0	0	3	25	75	100
3	PEC		Program Specific Elective-III	3	0	0	3	25	75	100
4	PEC		Program Specific Elective-IV	3	0	0	3	25	75	100
5	AUD		Audit course 2	2	0	0	0	25	75	100
6	PCC	MSP251	Pattern Recognition and Machine Learning Lab	0	0	4	2	15	35	50
7	PCC	MSP252	Detection and Estimation Theory Lab	0	0	4	2	15	35	50
8	PCC	MSP253	Minor Project	0	0	4	2	15	35	50
			Total Credits				**18**	170	480	650

	Course Name	Course Title
Program Elective-III	MSPE201	Advanced Computer Architecture
	MSPE202	IOT and Applications
	MSPE203	Digital Design and Verification
Program Elective-IV	MSPE204	Multispectral Signal Analysis
	MSPE205	Audio Processing
	MSPE206	Biomedical Signal Processing

AUD 2 (Audit 2 should be different from audit 1)	**AUD01A**	English for Research Paper Writing
	AUD02A	Disaster Management
	AUD03A	Sanskrit for Technical Knowledge
	AUD04A	Value Education
	AUD05A	Constitution of India
	AUD06A	Pedagogy Studies
	AUD07A	Stress Management by Yoga
	AUD08A	Personality Development through Life Enlightenment Skills.
	AUD09A	Vivekananda Thoughts

Semester III

M. Tech. (Signal Processing)

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PEC		Program Specific Elective-V	3	0	0	3	25	75	100
2	OEC		Open Elective	3	0	0	3	25	75	100
3	PCC	MSP351	Dissertation Phase – I	0	0	20	10	100	200	300
			Total Credits				**16**	150	350	500

	Course Name	Course Title
Program Elective-V	MSPE301	Artificial Intelligence
	MSPE302	Optimization Techniques
	MSPE303	Modelling and Simulation Techniques
Open Elective	MECO-301	Business Analytics
	MECO-302	Industrial Safety
	MECO-303	Operations Research
	MECO-304	Cost Management of Engineering Projects
	MECO-305	Composite Materials
	MECO-306	Waste to Energy

Semester IV

M. Tech. (Signal Processing)

Sr. No.	Category	Course Code	Course Title	Hours per week			Credits	Sessional Marks	Final Marks	Total
				L	T	P				
1	PCC	MSP401	Dissertation Phase – II	0	0	32	16	200	300	500
			Total Credits				**16**	200	300	500

SEMESTER –I

MSP101 **Advanced Digital Signal Processing**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective: Students will be able:

- To study theory of different filters and algorithms.
- To study theory of multirate DSP, write algorithms and solve problems on DSP.
- To study theory of prediction and solution of normal equations.
- To familiar with applications of DSP at block level.

Syllabus

Unit 1: Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures, Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.

Unit 2: Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding.

Unit 3: Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit 4: Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

Unit 5: Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

Unit 6: Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.

References:

- J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
- N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
- Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
- M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.

- S.Haykin, “Adaptive Filter Theory”, 4th Edition, Prentice Hall, 2001.
- D.G.Manolakis, V.K. Ingle and S.M.Kogon, “Statistical and Adaptive Signal Processing”, McGraw Hill, 2000.

Course Outcomes

- The outcome of this course is to familiarize the prospective engineers with techniques in different filters, multirate DSP, algorithms and solve problems on DSP. It aims to familiar the students with standard concepts prediction and solution of normal equations and applications of DSP at block level.

MSP102 **Digital Image and Video Processing**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective:

Students will be able to

- To study and learn different techniques for image enhancement, video and image recovery.
- To study different techniques for image and video segmentation.
- To study different techniques for image and video compression and object recognition.

Syllabus Contents:

Unit 1: **Digital Image and Video Fundamentals**: Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform

Unit 2: **Image and Video Enhancement and Restoration:** Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery).

Unit 3: **Image and Video Segmentation**: Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.

Unit 4: **Colour image Processing**: Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing

Unit 5: **Image and Video Compression**: Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), Video Quality Assessment

Unit 6: **Object recognition**: Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, Template matching, Bayes classifier

References:

- Ed. Al Bovik ,"Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.

- J. W. Woods, “Multidimensional Signal, Image and Video Processing and Coding”, 2nd Edition, Academic Press, 2011.
- Rafael C. Gonzalez and Richard E. Woods,” Digital Image Processing”, 3rd Edition, Prentice Hall, 2008.
- A. M. Tekalp, “Digital Video Processing”, 2nd Edition, Prentice Hall, 2015.
- S. Shridhar, “Digital Image Processing”, 2nd Edition, Oxford University Press, 2016.

Course Outcomes

The outcoms of this course is to exposure techniques in image enhancement, video and image recovery also give exposure to the students in different techniques for image and video segmentation, image and video compression and object recognition.

MSPE101 **DSP Architecture (Elective -I)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective:

Students will be able

- To study architectural level characterization of P-DSP hardware.
- To study design, programming (assembly and C), and testing code using Code Composer Studio environment.
- To study and deployment of DSP hardware for Control, Audio and Video Signal processing applications.
- To understanding of major areas and challenges in DSP based embedded systems

Syllabus Contents:

Unit 1: Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

Unit 2: Structural and Architectural Considerations: Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

Unit 3: VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

Unit 4: Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).

Unit 5: FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.

Unit 6: High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

- M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
- Fayez Gebali, "Algorithms and Parallel Computing",1st Edition, John Wiley & Sons, 2011
- Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
- Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
- Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
- E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007.

Course Outcomes:

- The outcomes of this course is to exposure techniques architectural level characterization of P-DSP hardware also programming (assembly and C), and testing code using Code Composer Studio environment.

MSPE102 **Computer Vision (Elective -I)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective:

Students will be able

- To study the image formation models and feature extraction for computer vision.
- Identify the segmentation, motion detection and different estimation techniques.
- To study and develop small applications and detect the objects in various applications.

Syllabus Contents:

Unit 1: **Image Formation Models**: Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems, Perspective, Binocular Stereopsis, Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework, Auto-calibration. Apparel, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework, Auto-calibration, Apparel, Stereo vision.

Unit 2: **Feature Extraction**: Image representations (continuous and discrete), Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces, Phong Model; Reflectance Map, Albedo estimation, Photometric Stereo, Use of Surface Smoothness Constraint, Shape from Texture, color, motion and edges.

Unit 3: **Shape Representation and Segmentation:** Deformable curves and surfaces, Snakes and active contours, Level set representationsm, Fourier and wavelet descriptors, Medial representations, Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation

Unit 4: **Motion Detection and Estimation:** Regularization theory, Optical computation, Stereo Vision Motion estimation, Background Subtraction and Modelling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation, Structure from motion, Motion Tracking in Video.

Unit 5: **Object recognition:** Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition.

Unit 6: **Applications of Computer Vision:** Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing.

References:

- D. Forsyth and J. Ponce,"Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
- Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, Springer-Verlag London Limited, 2011.
- Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
- K. Fukunaga,"Introduction to Statistical Pattern Recognition",2nd Edition, Morgan Kaufmann, 1990.
- Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
- B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
- E. R. Davies"Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc,2012.

Course Outcomes

- The outcomes of this course is to exposure techniques image formation models and feature extraction for computer vision, motion detection and different estimation techniques and also to familiar detect the objects in various applications

MSPE103 **Remote Sensing (Elective -I)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Students shall be able

- To study basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles.
- To study applications of principles to a variety of topics on remote sensing, especially emphasis on related to the data collection, radiation, resolution, and sampling.

Syllabus Contents:

Unit 1: Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Unit 2: Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned space crafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc.

Unit 3: Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film - Optomechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery - calibration of thermal scanners.

Unit 4: Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT –Scattero meter, Altimeter-LiDAR remote sensing, principles, applications.

Unit 5: Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit 6: Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping.

References:

- Lillesand.T.M. and Kiefer.R.W,"Remote Sensing and Image interpretation", 6th Edition, John Wiley & Sons, 2000.
- John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, Prentice Hall,1995.
- Richards, John A., Jia, Xiuping, "Remote Sensing Digital Image Analysis",5th Edition, Springer-Verlag Berlin Heidelberg, 2013.
- Paul Curran P.J. Principles of Remote Sensing, 1st Edition, Longman Publishing Group, 1984.
- Charles Elachi, Jakob J. van Zyl, "Introduction to The Physicsand Techniques of Remote Sensing", 2nd Edition, Wiley Serie, 2006.
- Sabins, F.F.Jr, "Remote Sensing Principles and Image Interpretation", 3rd Edition, W.H.Freeman& Co, 1978.

Course Outcomes

- The outcomes of this course is to exposure basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles also applications of variety of topics on remote sensing.

MSPE104 **Joint Time Frequency Analysis & Multi Resolution Analysis (Elective -II)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective:

Students will be able

- To study transforms in signal processing
- To study Time -Frequency Analysis & Multiresolution Analysis
- To study and study of Wavelets and its Applications

Syllabus Contents:

Unit 1: Introduction Review of Fourier Transform, Parseval Theorem and need for joint time-frequency Analysis.Concept of non-stationary signals, Short-time Fourier transforms (STFT), Uncertainty Principle, and Localization/Isolation in time and frequency, Hilbert Spaces, Banach Spaces, and Fundamentals of Hilbert Transform.

Unit 2: **Bases for Time-Frequency Analysis:** Wavelet Bases and filter Banks, Tilings of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous Frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.

Unit 3: **Multiresolution Analysis:** Haar Multiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of up samplers and down samplers, Conditions for alias cancellation and perfect reconstruction, Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal framework of Haar 2band filter bank.

Unit 4: **Wavelets:** Daubechies Wavelet Bases, Daubechies compactly supported family of wavelets, Daubechies filter coefficient calculations, Case study of Daub-4 filter design, Connection between Haar and Daub-4, Concept of Regularity, Vanishing moments. Other classes of wavelets like Shannon, Meyer, and Battle-Lamarie.

Unit 5: **Bi-orthogonal wavelets and Applications:** Construction and design. Case studies of biorthogonal 5/3 tap design and its use in JPEG 2000. Wavelet Packet Trees, Time-frequency localization, compactly supported wavelet packets, case study of Walsh wavelet packet bases generated using Haar conjugate mirror filters till depth level 3. Lifting schemes for generating orthogonal bases of second generation wavelets.

Unit 6: **JTFA Applications:** Riesz Bases, Scalograms, Time-Frequency distributions: fundamental, ideas, Applications, Speech, audio, image and video compression; signal denoising, feature extraction, inverse problem.

References:

- S. Mallat, "A Wavelet Tour of Signal Processing," 2nd Edition, Academic Press, 1999.
- L. Cohen, “Time-frequency analysis”, 1st Edition, Prentice Hall, 1995.
- G.Strang and T. Q. Nguyen, “Wavelets and Filter Banks",2nd Edition, Wellesley Cambridge Press, 1998.
- I. Daubechies, "Ten Lectures on Wavelets", SIAM, 1992.
- P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.
- M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding", Prentice Hall, 1995

Course Outcomes

The outcome of this course is to exposure basic concepts, principles of transforms in signal processing, Time-Frequency analysis & multire solution Analysis and applications of wavelets.

MSPE105 **Voice and Data Networks (Elective -II)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective:

Students will be able

- To study the Protocol, algorithms, and trade-offs rationale.
- To exposure of Routing, transport, and DNS resolutions.
- To familiar with Network extensions and next generation architectures.

Syllabus Contents:

Unit 1: Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

Unit 2: Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

Unit 3: Data Networks and their Design, Link layer design, Link adaptation, Link Layer Protocols, Retransmission, Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

Unit 4: Queuing Models of Networks , Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks,

Unit 5: Inter-networking , Bridging, Global Internet , IP protocol and addressing , Sub netting , Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet, End to End Protocols, TCP and UDP, Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.

Unit 6: Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks, Network Calculus, Packet Scheduling Algorithms.

References:

- D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
- L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition, Morgan Kaufman, 2011.
- Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
- Walrand,"Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
- Leonard Kleinrock, "Queueing Systems,Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
- Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.

- Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987.

Course Outcome

- The outcome of this course is to exposure basic concepts, principles of Protocol, algorithms, and trade-offs rationale. And also exposure of Routing, transport, and DNS resolutions familiar with Network extensions and next generation architectures.

MSPE106 **Audio Video Coding &Compression (Elective -II)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objective:

Students will be able

- To familiarity lossless compression systems.
- To study and implement of Video coding techniques and standards.
- To implement audio coding and multimedia synchronization techniques.

Syllabus Contents:

Unit 1: Introduction to Multimedia Systems and Processing, Lossless Image Compression Systems Image Compression Systems, Huffman Coding, Arithmetic and Lempel-Ziv Coding, Other Coding Techniques

Unit 2: Lossy Image Compression Systems, Theory of Quantization, Delta Modulation and DPCM, Transform Coding & K-L Transforms, Discrete Cosine Transforms, Multi-Resolution Analysis, Theory of Wavelets, Discrete Wavelet Transforms, Still Image Compression Standards, JBIG and JPEG

Unit 3: Video Coding and Motion Estimation: Basic Building Blocks & Temporal Redundancy, Block based motion estimation algorithms, Other fast search motion estimation algorithms

Unit 4: Video Coding Standards MPEG-1 standards, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard

Unit 5: Audio Coding, Basic of Audio Coding, Audio Coding, Transform and Filter banks, Polyphase filter implementation, Audio Coding, Format and encoding, Psychoacoustic Models

Unit 6: Multimedia Synchronization, Basic definitions and requirements, References Model and Specification, Time stamping and pack architecture, Packet architectures and audio-video interleaving, Multimedia Synchronization, Playback continuity, Video Indexing And Retrieval: Basics of content based image retrieval, Video Content Representation, Video Sequence Query Processing

References:

- Iain E.G. Richardson, "H.264 and MPEG-4 Video Compression", Wiley, 2003.
- Khalid Sayood, "Introduction to Data Compression", 4th Edition, Morgan Kaufmann, 2012
- Mohammed Ghanbari, "Standard Codecs: Image Compression to Advanced Video Coding", 3rd Edition, The Institution of Engineering and Technology, 2011.
- Julius O. Smith III, "Spectral Audio Signal Processing", W3K Publishing, 2011.
- Nicolas Moreau, "Tools for Signal Compression: Applications to Speech and Audio Coding", Wiley, 2011.

Course Outcomes

The outcome of this course is to exposure basic concepts of lossless compression systems and implement of Video coding techniques and standards.

MSP151 **Lab 1 : Advanced Digital Signal Processing lab**

L T P CR			
0 0 4 2	**Theory**	**:**	35
	Class Work	**:**	15
	Total	**:**	50
	Duration of Exam	**:**	**3 hrs**

Course Objective:

Students will be able

- To study and design different digital filters in software.
- To implement various transforms in time and frequency domain,
- To implement different decimation and interpolation techniques.

List of Experiments:

1. Basic Signal Representation
2. Correlation Auto And Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
6. Chebychev Type I,II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation And Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution And M Fold Decimation &PSD Estimator
13. Estimation Of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation Of T/F.
17. Parallel Realization of IIR filter.

MSP152 **Lab 2 : Digital Image and Video Processing lab**

L T P CR			
0 0 4 2	**Theory**	**:**	35
	Class Work	**:**	15
	Total	**:**	50
	Duration of Exam	**:**	**3hrs**

Course Objective:

Students will be able

- To implement and design image and video enhancement.
- To implement image and video segmentation.
- To study detection of an object in an image/video.

List of Experiments:

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

RMI101 **Research Methodology and IPR**

L T P CR			
2 0 0 2	**Theory**	**:**	75
	Class Work	**:**	25
	Total	**:**	100
	Duration of Exam	**:**	**3 hrs**

Course Objective: Students will be able

- To study research problem formulation.
- To study research related information
- Familiar and follow research ethics
- To study that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- To studding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- To study that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2: Effective literature studies approaches, analysis Plagiarism and Research ethics.

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Unit 4: Nature of Intellectual Property, Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario, International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights, Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR, Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.

- Niebel , “Product Design”, McGraw Hill, 1974.
- Asimov , “Introduction to Design”, Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes

- The outcome of this course is to exposure research problem formulation, research related information and how IPR would take such important place in growth of individuals & nation.

Semester II

MSP201	**Pattern Recognition and Machine Learning**		
L T P CR	**Theory**	**:**	**75**
3 0 0 3	**Class Work**	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study the parametric and linear models for classification.
- To study and Design neural network and SVM for classification.
- To study and develop machine independent and unsupervised learning techniques.

Syllabus Contents:

Unit 1: **Introduction to Pattern Recognition**: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning, Maximum likelihood and Bayesian Decision Theory, Bayes rule, discriminant functions, loss functions and Bayesian error analysis

Unit 2: **Linear models:** Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

Unit 3: **Neural Network**: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning

Unit 4: **Linear discriminant functions:** decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

Unit 5: **Algorithm independent machine learning:** lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

Unit 6: **Unsupervised learning and clustering:** k-means clustering, fuzzy k-means clustering, hierarchical clustering.

References:

- Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
- C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

Course Outcomes

- The outcome of this course is to exposure parametric and linear models for classification, design neural network and SVM for classification and also familiar to develop machine independent and unsupervised learning techniques.

MSP202 **Detection and Estimation Theory**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study the mathematical background of signal detection and estimation.
- To study and use classical and Bayesian approaches to formulate problems.
- To study signal detection and parameter estimation from noisy signals.
- To study filtering methods for parameter estimation.

Syllabus

Unit 1: Review of Vector Spaces: Vectors and matrices: notation andproperties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigen values and eigenvectors.

Unit 2: **Properties of Symmetric Matrices:** Diagonalizationof symmetric matrices, symmetric positive definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

Unit 3: **Stochastic Processes:** Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclostationary process, and spectral factorization.

Unit 4: **Detection Theory:** Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes‘ criterion of signal detection, MAP, LMS, entropy detectors, detection in colored Gaussian noise, Karhunen-Loeve expansions and whitening filters.

Unit 5: **Estimation Theory:** Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms.

Unit 6: **Topics in Kalman and Weiner Filtering:** Discrete time Wiener-Hopf equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter, examples. Specialized Topics in Estimation:Spectral estimation methodslike MUSIC, ESPIRIT, DOA Estimation.

References:

- Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory”, Prentice Hall, 1993
- Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume II: Detection Theory”, 1st Edition, Prentice Hall, 1998
- Thomas Kailath, BabakHassibi, Ali H. Sayed, “Linear Estimation”, Prentice Hall, 2000.

- H. Vincent Poor, “An Introduction to Signal Detection and Estimation”, 2nd Edition, Springer, 1998.

Course Outcomes

- The outcome of this course is to exposure mathematical background of signal detection and estimation, classical and Bayesian approaches to formulate problems and also familiar with signal detection and parameter estimation from noisy signals.

MSPE201 **Advanced Computer Architecture (Elective -III)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study parallelism and pipelining concepts, the design aspects and challenges.
- To familiar with the issues in vector and array processors.
- To study and analyze the high performance scalable multithreaded and multiprocessor systems.

Syllabus Contents:

Unit 1: **Parallel Processing and Pipelining Processing:** Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture

Unit 2: **Pipeline Architecture:** Principles and implementation of Pipelining, Classification of pipelining processors, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Advanced pipelining techniques, Software pipelining, VLIW (Very Long Instruction Word) processor.

Unit 3: **Vector and Array Processor:** Issues in Vector Processing, Vector performance modeling, SIMD Computer Organization, Static Vs Dynamic network, Parallel Algorithms for Array Processors: Matrix Multiplication.

Unit 4: **Multiprocessor Architecture:** Loosely and Tightly coupled multiprocessors, Inter Processor communication network, Time shared bus, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherency and bus snooping, Massively Parallel Processors (MPP).

Unit 5: **Multithreaded Architecture:** Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques, Message passing program development.

Unit 6: **Parallel algorithms for multiprocessors:** Classification and performance of parallel algorithms, operating systems for multiprocessors systems, Message passing libraries for parallel programming interface, PVM (in distributed memory system), Message Passing Interfaces (MPI).

References:

- Kai Hwang, Faye A. Briggs, "Computer Architecture and ParallelProcessing" McGraw Hill Education, 2012.
- Kai Hwang, "Advanced Computer Architecture", McGraw Hill Education, 1993.
- William Stallings, "Computer Organization and Architecture, Designing for Performance" Prentice Hall, 6th edition, 2006.
- Kai Hwang, "ScalableParallelComputing", McGraw Hill Education, 1998.
- Harold S. Stone "High-Performance Computer Architecture", Addison-Wesley, 1993

Course Outcomes

- The outcome of this course is to exposure parallelism and pipelining concepts, the design aspects and challenges also familiar with the issues in vector and array processors, multithreaded and multiprocessor systems.

MSPE202 **IOT and Applications (Elective -III)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study the concept of IOT and M2M.
- To exposure of IOT architecture and applications in various fields
- To study the security and privacy issues in IOT.

Syllabus Contents:

Unit 1: IoT& Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Unit 2: M2M to IoT, A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit 3: IoT Architecture, State of the Art, Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture, Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit 4: IoT Applications for Value Creations Introduction, IoT applications for industry, Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit 5: Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues.

Unit 6: Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

References:

- Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
- Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

- CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media, 2011.

Course Outcomes

- The outcome of this course is to exposure concept of IOT and M2M, IOT architecture and applications in various fields.

MSPE203 **IOT and Applications (Elective -III)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To familiar about front end design and verification techniques and create reusable test environments.
- To study and design increasingly complex designs more efficiently and effectively.
- To familiar about EDA tools like Cadence, Mentor Graphics.

Syllabus Contents:

Unit 1: **Revision of basic Digital systems:** Combinational Circuits, Sequential Circuits, Logic families Synchronous FSM and asynchronous design, Metastability, Clock distribution and issues, basic building blocks like PWM module, pre-fetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.

Unit 2: **Verilog/VHDL Comparisons and Guidelines, Verilog:** HDL fundamentals, simulation, and test-bench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS

Unit 3: **System Verilog and Verification:** Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization, Introduction to basic scripting language, Perl, Tcl/Tk

Unit 4: **Current challenges in physical design:** Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect &Electromigration

Unit 5: **Programmable Logic Devices:** Introduction, Evolution, PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, FPGA with technology, Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices.

Unit 6: **IP and Prototyping:** IP in various forms, RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues, Testing of logic circuits, Fault models, BIST, JTAG interface

References:

- Douglas Smith, “HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog”, Doone publications, 1998.
- Samir Palnitkar, “Verilog HDL: A guide to Digital Design and Synthesis”, Prentice Hall, 2nd Edition, 2003.

- Doug Amos, Austin Lesea, Rene Richter, “FPGA based Prototyping Methodology Manual”, Synopsys Press, 2011.
- Christophe Bobda, “Introduction to Reconfigurable Computing, Architectures, Algorithms and Applications”, Springer, 2007.
- Janick Bergeron, “Writing Testbenches: Functional Verification of HDL Models”, Second Edition, Springer, 2003.

Course Outcomes

- The outcome of this course is to exposure concept of front end design and verification techniques and to create reusable test environments also get familiar with how design increasingly complex designs more efficiently and effectively.

MSPE204 **Multispectral Signal Analysis (Elective -IV)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study about t appropriate hyperspectral data for a particular application.
- To study basic concepts of data acquisition and image processing tasks required for multi and hyperspectral data analysis.
- To understand and learn techniques for classification and analysis of multi and hyperspectral data.

Syllabus

Unit 1: **Hyperspectral Sensors and Applications:** Introduction, Multi-spectral Scanning Systems (MSS), Hyperspectral Systems, Airborne sensors, Spaceborne sensors, Ground Spectroscopy, Software for Hyperspectral Processing, Applications, Atmosphere and Hydrosphere, Vegetation, Soils and Geology, Environmental Hazards and Anthropogenic Activity

Unit 2: **Overview of Image Processing:** Introduction, Image File Formats, Image Distortion and Rectification, Radiometric Distortion, Geometric Distortion and Rectification, Image Registration, Image Enhancement, Point Operations, Geometric Operation, Image Classification, Supervised Classification, Unsupervised Classification, Crisp Classification Algorithms, Fuzzy Classification Algorithms, Classification Accuracy Assessment, Image Change Detection, Image Fusion, Automatic Target Recognition

Unit 3: **Mutual Information:** A Similarity Measure for Intensity Based Image Registration, Introduction, Mutual Information Similarity Measure, Joint Histogram Estimation Methods, Two-Step Joint Histogram Estimation, One-Step Joint Histogram Estimation, Interpolation Induced Artifacts, Generalized Partial Volume Estimation of Joint Histograms, Optimization Issues in the Maximization of MI

Unit 4: **Independent Component Analysis:** Introduction, Concept of ICA, ICA Algorithms, Preprocessing using PCA, Information Minimization Solution for ICA, ICA Solution through Non-Gaussianity Maximization, Application of ICA to Hyperspectral Imagery, Feature Extraction Based Model, Linear Mixture Model Based Model, An ICA algorithm for Hyperspectral Image Processing, Applications using ICA.

Unit 5: **Support Vector Machines:** Introduction, Statistical Learning Theory, Empirical Risk Minimization, Structural Risk Minimization, Design of Support Vector Machines, Linearly Separable Case, Linearly Non-Separable Case, Non-Linear Support Vector Machines, SVMs for Multiclass Classification, One Against the Rest Classification, Pair wise Classification, Classification based on Decision Directed Acyclic Graph and Decision Tree Structure, Multiclass Objective Function, optimization Methods , Applications using SVM.

Unit 6: **Markov Random Field Models:** Introduction, MRF and Gibbs Distribution, Random Field and Neighborhood, Cliques, Potential and Gibbs Distributions, MRF

Modeling in Remote Sensing Applications, Optimization Algorithms, Simulated Annealing, Metropolis Algorithm, Iterated Conditional Modes Algorithm.

References:

- Pramod K. Varshney, Manoj K. Arora, "Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data", Springer, 2013.
- S. Svanberg, "Multi-spectral Imaging– from Astronomy to Microscopy – from Radio waves to Gamma rays", Springer Verlag, 2009

Course Outcomes

The outcome of this course is to exposure concept about appropriate hyperspectral data for a particular application and also gets familiar with basic concepts of data acquisition and image processing.

MSPE205 **Audio Processing (Elective -IV)**

L T P CR	**Theory**	**:**	**75**
3 0 0 3	**Class Work**	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study different characteristics of Speech.
- To study and analyze different speech analysis system.
- To study and design algorithms for recognition of speech.

Syllabus Contents:

Unit 1: **Principle Characteristics of Speech:** Linguistic information, Speech and Hearing, Speech production mechanism, Acoustic characteristic of speech Statistical Characteristics of speech. Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model.

Unit 2: **Speech Analysis and Synthesis Systems:** Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and Short Time Fourier transform, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis, Pitch Extraction.

Unit 3: Linear Predictive Coding Analysis: Principle of LPC analysis, Maximum likelihood spectral estimation, Source parameter estimation from residual signals, LPC Encoder and Decoder, PARCOR analysis and Synthesis, Line Spectral Pairs, LSP analysis and Synthesis.

Unit 4: **Speech Coding:** Reversible coding, Irreversible coding and Information rate distortion theory, coding in time domain, PCM, ADPCM, Adaptive Predictive coding, coding in Frequency domain: Sub band coding, Adaptive transform coding, Vector Quantization, Code Excited Linear Predictive Coding (CELP).

Unit 5: **Speech Recognition:** Principles of speech recognition, Speech period detection, Spectral distance measure, Structure of word recognition system, Dynamic Time Warping (DTW), Theory and implementation of Hidden Markov Model (HMM).

Unit 6: **Speaker recognition:** Human and Computer speaker recognition Principles Text dependent and Text Independent speaker recognition systems, Applications of speech Processing.

References:

- SadaokiFurui, “Digital Speech Processing, Synthesis and Recognition” 2nd Edition, Taylor & Francis, 2000.

- Rabiner and Schafer, “Digital Processing of Speech Signals”, Pearson Education, 1979.

Course Outcomes

- The outcome of this course is to exposure concept different characteristics of speech also analyze different speech analysis system.

MSPE206 **Biomedical Signal Processing (Elective -IV)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study different types of biomedical signal.
- To analyze and identify different biomedical signals.
- Exposure and applications related to biomedical signal processing

Syllabus Contents:

Unit 1: Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, study of diagnostically significant bio-signal parameters

Unit 2: Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering

Unit 3: Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)

Unit 4: Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications.

Unit 5: Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multiresolution analysis(MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA).

Unit 6: Pattern classification–supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.

References:

- W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993.
- Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication, 2001.
- Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
- D C Reddy, "Biomedical Signal Processing", McGraw Hill, 2005.
- Katarzyn J. Blinowska, JaroslawZygierewicz, "Practical Biomedical Signal Analysis Using
  MATLAB", 1st Edition, CRC Press, 2011.

Course Outcomes

- The outcome of this course is to exposure concept different types of biomedical signal and applications related to biomedical signal processing.

MSP251 **Lab 1: Pattern Recognition & Machine Learning Laboratory**

L T P CR			
0 0 4 2	**Theory**	**:**	**35**
	Class Work	**:**	**15**
	Total	**:**	**50**
	Duration of Exam	**:**	**3 hrs**

Course Objective

Students will be able

- To study and familiar with image and video enhancement.
- To study and perform image and video segmentation.
- To study and design detection of an object in an image/video.
- To design and implement different algorithms for pattern recognition.

List of Experiments:

1. Implement maximum likelihood algorithm.
2. Implement Bayes classifier.
3. Implement linear regression.
4. Design a classifier using perceptron rule.
5. Design a classifier using feedforward back-propagation and delta rule algorithms.
6. Implement deep learning algorithm.
7. Implement linear discriminant algorithm.
8. Design a two class classifier using SVM.
9. Design a multiclass classifier using SVM.
10. Perform unsupervised learning.

MSP252 **Lab 2: Detection and Estimation Theory Laboratory**

L T P CR			
0 0 4 2	**Theory**	**:**	**35**
	Class Work	**:**	**15**
	Total	**:**	**50**
	Duration of Exam	**:**	**3 hrs**

Course Objective:

Students will be able

- To study and simulate signals and noise.
- To design and implement detection of signals in the presence of noise.
- Familiar with various estimation & detection techniques.

List of Experiments:

1. Simulate signal and noise models models.
2. Simulate spatially separated target Signal in the presence of Additive Correlated White Noise
3. Simulate spatially separated target Signal in the presence of Additive Uncorrelated White Noise
4. Simulate spatially separated target Signal in the presence of Additive Correlated Colored Noise
5. Detect Constant amplitude Signal in AWGN
6. Detect Time varying Known Signals in AWGN
7. Detect Unknown Signals in AWGN
8. Compare performance comparison of the Estimation techniques - MLE, MMSE, Bayes Estimator, MAP Estimator, Expectation Maximization (EM) algorithm
9. Performance comparison of conventional Energy Detectors and Coherent Matched Filter Techniques.

MSP253 **Minor Project**

L T P CR			
0 0 4 2	**Theory**	**:**	**35**
	Class Work	**:**	**15**
	Total	**:**	**50**
	Duration of Exam	**:**	**3 hrs**

Course Objective:

Students will be able

- To study of contemporary/emerging technology for various processes and systems.
- To study, design and share knowledge effectively in oral and written form and formulate documents.

Syllabus

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

Semester III

MSPE301 **Artificial Intelligence (Elective- V)**

L T P CR	**Theory**	**:**	**75**
3 0 0 3	**Class Work**	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study the concept of Artificial Intelligence, search techniques and knowledge representation issues.
- To study reasoning and fuzzy logic for artificial intelligence
- To study game playing and natural language processing.

Syllabus Contents:

Unit 1: **What is AI (Artificial Intelligence)?:** The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques, Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems, Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

Unit 2: **Knowledge Representation Issues:** Representations And Mappings, Approaches To Knowledge, Representation, Using Predicate Logic, Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Unit 3: **Symbolic Reasoning Under Uncertainty:** Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, DempsterShafer Theory

Unit 4: **Fuzzy Logic. Weak Slot-and-Filler Structures:** Semantic Nets, Frames. Strong Slot-and-Filler Structures, Conceptual Dependency, Scripts, CYC.

Unit 5: Game Playing, Overview, And Example Domain, Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction

Unit 6: **Natural Language Processing:** Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking

Connectionist Models, Introduction, Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.

References:

- Elaine Rich and Kevin Knight "Artificial Intelligence", 2nd Edition, Tata Mcgraw-Hill, 2005.
- Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.

Course Outcomes

The outcome of this course is to exposure concept of artificial Intelligence and also fuzzy logic for artificial intelligence.

MSPE302 **Optimization Techniques (Elective- V)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study importance of optimization.
- To study the basic concepts of mathematics to formulate an optimization problem Analyze.
- To study and appreciate variety of performance measures for various optimization problems.

Syllabus Contents:

Unit 1: Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Unit 2" Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

Unit 3: Single Variable Optimization Problems, Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method, Gradient Based Methods, Newton-Raphson Method, Bisection Method, Secant Method Cubic search method.

Unit 4: Multi Variable and Constrained Optimization Technique, Optimality criteria , Direct search Method, Simplex search methods, Hooke-Jeeve‘s pattern search method, Powell‘s conjugate direction method, Gradient based method, Cauchy‘s Steepest descent method, Newton‘s method, Conjugate gradient method. Kuhn, Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

Unit 5: Intelligent Optimization Techniques, Introduction to Intelligent Optimization, Soft Computing, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Graph Grammer Approach, Example Problems

Unit 6: Genetic Programming (GP), Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

References:

- S. S. Rao, “Engineering Optimisation: Theory and Practice”, Wiley, 2008.
- K. Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall, 2005.
- C.J. Ray, “Optimum Design of Mechanical Elements”, Wiley, 2007.

- R. Saravanan, "Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
- D. E. Goldberg, "Genetic algorithms in Search, Optimization, and Machine learning", Addison-Wesley Longman Publishing, 1989.

Course Outcomes

- The outcome of this course is to exposure concept importance of optimization and to give basic concepts of mathematics to formulate an optimization problem analyze.

MSPE303 **Modelling and Simulation Techniques (Elective- V)**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 hrs.**

Course Objective:

Students will be able

- To study different discrete systems (deterministic and random).
- To study different model of discrete signals (deterministic and random)
- To study modelling and simulation techniques to characterize systems/processes.

Syllabus Contents:

Unit 1: Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.

Unit 2: Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.

Unit 3: Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, Monte-Carlo Methods.

Unit 4: Stochastic Processes and Markov Chains, Time Series Models.

Unit 5: Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.

Unit 6: Continuous simulation, Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics.

References:

- R. L. Woods and K. L. Lawrence, "Modeling and Simulation of Dynamic Systems", Prentice-Hall, 1997.
- Z. Navalih, "VHDL Analysis and Modelling of Digital Systems", McGraw-Hill, 1993.
- J. Banks, JS. Carson and B. Nelson, "Discrete-Event System Simulation", 2nd Edition, Prentice-Hall of India, 1996.

Course Outcomes

The outcome of this course is to exposure concept of different model of discrete systems (deterministic and random) and simulation techniques to characterize systems/processes.

MSP351 **Dissertation Phase – I**

L	**T**	**P**	**CR**			
0	**0**	**20**	**10**	**Theory**	**:**	**200**
				Class Work	**:**	**100**
				Total	**:**	**300**

Course Outcomes:

Students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

Semester IV

MSP401 **Dissertation Phase – II**

L	**T**	**P**	**CR**			
0	**0**	**32**	**16**	**Theory**	**:**	**300**
				Class Work	**:**	**200**
				Total	**:**	**500**

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II at M. Tech.

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/ performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.

OPEN ELECTIVES

MECO-301 **Business Analytics**

L T P CR
3 0 0 3

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Course Objectives:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Syllabus

Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools, Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression, Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Course Outcomes: On successful complete of this course, the students should be able to:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

MECO-302 **Industrial Safety**

L T P CR

3 0 0 3

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Syllabus

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v, Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

MECO-303 **Operations Research**

L T P CR

3 0 0 3

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Syllabus

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2 Formulation of a LPP, Graphical solution revised simplex method, duality theory, dual simplex method - sensitivity analysis - parametric programming

Unit 3: Nonlinear programming problem, Kuhn-Tucker conditions min cost flow problem, max flow problem, CPM/PERT

Unit 4: Scheduling and sequencing - single server and multiple server models, deterministic inventory models, Probabilistic inventory control models, Geometric Programming.

Unit 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Course Outcomes: At the end of the course, the student should be able to

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real world problem and simulate it.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MECO-304 **Cost Management of Engineering Projects**

L T P CR			
3 0 0 3	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Syllabus

Unit 1: Introduction and Overview of the Strategic Cost Management Process

Unit 2: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities, Pre project execution main clearances and documents Project team, Role of each member. Importance Project site, Data required with significance. Project contracts, Types and contents, Project execution Project cost control, Bar charts and Network diagram, Project commissioning, mechanical and process.

Unit 3: Cost Behavior and Profit Planning Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Standard Costing and Variance Analysis, Pricing strategies, Pareto Analysis, Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints, Activity-Based Cost Management, Bench Marking, Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets, Performance budgets, Zero-based budgets, Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit 4: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

MECO-305 **Composite Materials**

L T P CR
3 0 0 3

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Syllabus

UNIT–I: **INTRODUCTION:** Definition, Classification and characteristics of Composite materials, Advantages and application of composites, Functional requirements of reinforcement and matrix, Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: **REINFORCEMENTS:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements, Mechanical Behavior of composites, Rule of mixtures, Inverse rule of mixtures, Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding, Hot isostatic pressing, Properties and applications, Manufacturing of Ceramic Matrix Composites, Liquid Metal Infiltration, Liquid phase sintering, Manufacturing of Carbon, Carbon composites, Knitting, Braiding, Weaving, Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs hand layup method, Autoclave method, Filament winding method, Compression moulding, Reaction injection moulding. Properties and applications.

UNIT V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, Maximum strain criteria, interacting failure criteria, hygrothermal failure, Laminate first play failure-insight strength, Laminate strength-ply discount truncated maximum strain criterion, strength design using caplet plots, stress concentrations.

TEXT BOOKS:

1. Material Science and Technology, Vol 13, Composites by R.W.Cahn, VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials, K.K.Chawla.
3. Composite Materials Science and Application, Deborah D.L. Chung.
4. Composite Materials Design and Applications, Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

MECO-306 **Waste to Energy**

L T P CR
3 0 0 3

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs.

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW, Conversion devices, Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis, Types, slow fast, Manufacture of charcoal, Methods, Yields and application, Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers, Fixed bed system, Downdraft and updraft gasifiers, Fluidized bed gasifiers, Design, construction and operation, Gasifier burner arrangement for thermal heating, Gasifier engine arrangement and electrical power, Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves, Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation, Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition), Biogas plant technology and status, Bio energy system, Design and constructional features, Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, Direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, Types of biogas Plants, Applications, Alcohol production from biomass, Bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

ENGLISH FOR RESEARCH PAPER WRITING (AUD01A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course objectives:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Unit 5: skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Unit 6: useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's

Book .

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

DISASTER MANAGEMENT (AUD02A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives:

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Unit1: Introduction: Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Unit 2: Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Unit 3: Disaster Prone Areas In India: Study Of Seismic Zones, Areas Prone To Floods And Droughts, Landslides And Avalanches, Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami, Post-Disaster Diseases And Epidemics.

Unit 4: Disaster Preparedness And Management: Preparedness, Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk, Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports, Governmental And Community Preparedness.

Unit 5: Risk Assessment: Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation, Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Unit 6: Disaster Mitigation: Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation And Non-Structural Mitigation, Programs of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE (AUD03A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

Unit 1: Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences

Unit 2: Order, Introduction of roots, Technical information about Sanskrit Literature

Unit 3: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

VALUE EDUCATION (AUD04A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Unit 1: Values and self-development, Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non, moral valuation. Standards and principles, Value judgements

Unit 2: Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism.Love for nature ,Discipline

Unit 3: Personality and Behavior Development, Soul and Scientific, attitude, positive thinking, integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature

Unit 4: Character and Competence, Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

Suggested reading

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

CONSTITUTION OF INDIA (AUD05A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

Unit 1: History of Making of the Indian Constitution: History**,** Drafting Committee, (Composition & Working)

Unit 2: Philosophy of the Indian Constitution: Preamble, Salient Features.

Unit 3: Contours of Constitutional Rights & Duties: Fundamental Rights, Right to quality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Unit 4: Organs of Governance: Parliament, Composition, Qualifications and is qualifications, Powers and Functions, Executive, President, Governor, Council of Minister, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

Unit 5: Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj, Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat, Position and role, Block level, Organizational Hierarchy (Different departments), Village level, Role of Elected and Appointed officials, Importance of grass root democracy

Unit 6: Election Commission: Election Commission, Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission, Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Course Outcomes:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES (AUD06A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Unit 1: Introduction and Methodology: Aims and rationale, Policy background, Conceptual, framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions**,** Overview of methodology and Searching,

Unit 2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

Unit 3: Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4: Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

Unit 5: Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Course Outcomes:

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal, Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANAGEMENT BY YOGA (AUD07A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives

- To achieve overall health of body and mind
- To overcome stress

Syllabus

Unit 1: Definitions of Eight parts of yog. (Ashtanga)

Unit 2: Yam and Niyam, Do`s and Don't's in life., i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3: Asan and Pranayam, i) Various yog poses and their benefits for mind & body, ii)Regularization of breathing techniques and its effects-Types of pranayam

Course Outcomes:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (AUD08A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Unit 1: Neetisatakam-Holistic development of personality, Verses 19,20,21,22 (wisdom), Verses 29,31,32 (pride & heroism), Verses 26,28,63,65 (virtue), Verses 52,53,59 (dont's), Verses 71,73,75,78 (do's)

Unit 2: Approach to day to day work and duties, Shrimad Bhagwad Geeta, Chapter 2-Verses 41, 47,48, Chapter 3 Verses 13, 21, 27, 35, Chapter 6 Verses 5,13,17, 23, 35, Chapter 18 Verses 45, 46, 48.

Unit 3: Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2 Verses 56, 62, 68**,** Chapter 12 Verses 13, 14, 15, 16,17, 18**,** Personality of Role model. Shrimad Bhagwad Geeta, Chapter2 Verses 17, Chapter3 Verses 36,37,42, Chapter4 Verses 18, 38,39**,** Chapter18 Verses 37,38,63

Course Outcomes:

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit, Sansthanam, New Delhi.

SWAMI VIVEKANANDA'S THOUGHTS (AUD09A)

L T P CR			
2 0 0 0	**Theory**	**:**	**75**
	Class Work	**:**	**25**
	Total	**:**	**100**
	Duration of Exam	**:**	**3 Hrs.**

Course Objectives:

- To introduce biography and philosophical thought of Swami Vivekananda
- To present Swami Vivekananda's views on major religions of the world and Universal Religion
- To present Swami Vivekananda' teaching and views on social issues.

Syllabus

Unit 1: Swami Vivekananda a Brief biography, Influence of Ramakrishna on Vivekananda, Parliament of Religions, Establishment of Ramakrishna mission.

Unit 2: Philosophy of Swami Vivekananda, Nature of Reality, Nature of Self, Nature of the universe, The doctrine of Maya, Identity of Self and God, Karma Yoga, Raj Yoga , Bhakti Yoga, Gyan Yoga.

Unit 3: Swami Vivekananda's observations on major religions of the world (a) Hinduism (b) Christianity (c) Islam

Unit 4: The concept of Universal Religion and its characteristic, Fundamental unity of all religions, acceptance and not tolerance is the principle.

Unit 5: Vivekananda and Nationalism, The message of patriotism, spirituality as the basis of patriotism, Sociological views of Vivekananda, His views on caste and untouchability, status of women, His views on Education, Swami Vivekananda's concept of Vedantic Socialism

Books: The Complete Works of Swami Vivekananda Vol. 1 to 8 Relevant Chapters

Annexure-A

J.C. Bose University of Science & Technology, YMCA, Faridabad
(A Haryana State Government University)
(Established by Haryana State Legislative Act No. 21 of 2009 & Recognized by UGC Act 1956 u/s 22 to Confer Degrees)
Accredited 'A' Grade by NAAC

Implementation of Credit Transfer/Mobility Policy of online courses

Reference: Gazette of India (Extraordinary) Part-III, Section-4 No. 295, UGC **(Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016,** dated 19/07/2016.

With reference to 12th Academic Council Meeting dated 03/05/2017 (Agenda Item No. AC/11/12), wherein MOOCs were adopted in the CBCS scheme, In continuation to that, following modalities are proposed to introduce the credit transfer policy in academic curriculum for the Massive Open Online Courses (MOOC's) offered through SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) Portal.

A. General Guidelines

1. The SWAYAM shall notify in June and November every year, the list of the online learning Courses going to be offered in the forthcoming Semester on its website https://swayam.gov.in.
2. All the UTDs/Affiliated Colleges shall, within 4 weeks from the date of notification by SWAYAM, consider through their Chairperson/Principal the online learning courses being offered through the SWAYAM platform; and keeping in view their academic requirements, decide upon the courses which it shall permit for credit transfer and keeping in view the following points:

    a) There is non-availability of suitable teaching staff for running a course in the Department.
    b) The facilities for offering the elective papers (courses), sought for by the students are not on offer/scheme in the Institution, but are available on the SWAYAM platform.
    c) The courses offered on SWAYAM would supplement the teaching-learning process in the Institution.
    d) Online courses through SWAYAM should not be more than 20% of total courses offered in a particular semester of a programme.
3. The courses offered in a particular semester will be compiled by Digital India Cell as decided and forwarded by concerned UTDs and affiliated colleges in the prescribed format to digitalindia.ymca@gmail.com and compiled set will be put up in Academic Council for approval.
4. Student can opt for 12-16 weeks course equivalent to 3-6 credits under mentorship of faculty (MHRD MOOC's guidelines 11.1(J) issued by the MHRD vide its orders dated 11/03/2016).

Approved in 17th Academic Council Dated 11.06.2019

5. Every student being offered a particular paper (course) would be required to register for the MOOCs for that course/paper on SWAYAM through University's/Affiliated College's SWAYAM-NPTEL Local Chapter.

6. The UTD/College may designate a faculty member as course coordinator/mentor to guide the students (at least 20 students) throughout the course with 2 hours per week contribution and with mentor addition on the Local Chapter. The mentor Chairperson/Principal will ensure the provision of facilities for smooth running of the course viz. Internet facility and proper venue in the department/college.

7. Digital India Cell of the University will be the Nodal point for keeping track of MOOCs enrolments in the University and the concerned chairpersons/principals are expected to aware their students/faculty about the online courses.
8. Importance of online learning and credit transfer policy must be shared with the students at entry level by the concerned department/college. Same may be incorporated during induction program for newly admitted students.
9. The departmental/college MOOC coordinators appointed by chairpersons of concerned departments/Principals of affiliated colleges will be responsible for identification of relevant MOOCs in the UTDs/Colleges and smooth conduction during the course.

B. Credit Transfer/Mobility of MOOCs

1. The parent Institution (offering the Course) shall give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform in the credit plan of the program.
2. Following pattern will be followed for distribution of credits and will be applicable to all students from Jan 2018 onwards:

Program	**Duration**	**Minimum Credits to be earned***
B.Tech	Semester I to VIII	3
M.Tech/MBA/M.Sc./MA	Semester I to IV	3
BBA/BCA/B.Sc./BA	Semester I to VI	3

***All students of UTDs/Affiliated colleges of all courses have to mandatorily earn minimum prescribed credits.**

<u>Note:</u> From session 2019-20 onwards, for B.Tech program, a student has to earn at least 12 credits during the duration of the Degree subject to the passing of at least one MOOC course (carrying minimum 3 credits per year).

3. A student will be eligible to get Under-Graduate/Post-Graduate degree (B.Tech/M.Tech) with Honours if he/she completes additional credits through MOOC's. (AICTE Model Curriculum, Chapter1(B)). Following pattern will be

followed for earning additional credits for the award of Honours degree:

Program	**Duration**	**Credits to be earned***	**Minimum CGPA**
B.Tech	Semester I to VIII	12	8.0
M.Tech	Semester I to IV	6	8.0

*Inclusive of *Minimum credits to be earned* mentioned in clause B(2) above.

4. The earned credits shall be accepted and transferred to the total credits of the concerned students by the University for Completion of his/her degree. Credits earned through MOOCs will be incorporated in the mark sheet issued to the student by Controller of Examination.
5. Credits for MOOC's will be verified by the concerned department/college and will be forwarded to Controller of Examination for further processing.
6. The courses where model curriculum of AICTE is not applicable, pattern laid down as in B(2) will be followed.

NOTE:

These guidelines will be applicable to all Affiliating institutions under University along with all UTDs. Affiliating colleges will establish their own Local Chapter on SWAYAM and follow the same process.

1. For further clarifications, Notifications "Credit Framework for Online Learning Courses through SWAYAM" (UGC Regulations dated 19/07/2016) and "MHRD MOOC's guidelines" (MHRD guidelines dated 11/03/2016) may be referred.