E.G.S.PILLAY ENGINEERING COLLEGE

(Autonomous)

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B.E. Biomedical Engineering

Full Time Curriculum and Syllabus

Third Year – Sixth Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CIA	ES	Total
1901BM601	Diagnostic and Therapeutic Equipment - I	3	0	0	3	40	60	100
1902BM602	Analog and Digital Communication	3	0	0	3	40	60	100
1902BM603	Biomaterials	3	0	0	3	40	60	100
1903BM006	Professional Elective – II - Bio Analytical Methods and Instruments	3	0	0	3	40	60	100
1901HS002	HSS Elective – Intellectual Property Rights for Engineers	3	0	0	3	40	60	100
1902BM651	Diagnostic and Therapeutic Equipment Laboratory	0	0	4	2	50	50	100
1902BM652	Analog and Digital Communication Laboratory	0	0	4	2	50	50	100
1904BM653	Mini Project	0	0	4	2	50	50	100
1904BM654	Industrial Visit Presentation	0	0	2	1	100	-	100
1904GE651	Life Skills: Aptitude – II	0	0	2	1	100	-	100
Total		**15**	**0**	**16**	**23**	**550**	**450**	**1000**

1901BM601		Diagnostic and Therapeutic Equipment - I	L	T	P	C
			3	2	0	3

Course Objectives:

1. To Gather basic knowledge about measurements of parameters related to respiratory system
2. To Learn measurement techniques of sensory responses
3. To Understand different types and uses of diathermy units
4. To Know ultrasound imaging technique and its use in diagnosis
5. To discuss the importance of patient safety against electrical hazard

Unit I	CARDIAC EQUIPMENT	9 Hours

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac PacemakerInternal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External,Defibrillator Protection Circuit, Cardiac ablation catheter

Unit II	NEUROLOGICAL EQUIPMENT	9 Hours

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.

Unit III	MUSCULAR AND BIOMECHANICAL MEASUREMENTS	9 Hours

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.

Unit IV	RESPIRATORY MEASUREMENT SYSTEM	9 Hours

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

Unit V	SENSORY MEASUREMENT	9+3 Hours

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

Total:	45 Hours

Further Reading:

Understand the concepts of ultrasound equipment

Identify the electrical hazards and Implement methods of patient safety.

Course Outcomes:

After the Completion of the course, the student will be able to

1. Describe the measurement techniques of sensory responses
2. Analyse different types and uses of diathermy units
3. Discuss ultrasound imaging techniques and its usefulness in diagnosis
4. Outline the importance of patient safety against electrical hazard
5. Explain about measurements of parameters related to respiratory system

Text books:

1. John G. Webster, ―Medical Instrumentation Application and Design‖, 4th edition, Wiley India PvtLtd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, ―Introduction to Biomedical Equipment Technology‖, Pearson education, 2012.

References:	
1.	.Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003..
2.	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007
3.	John G. Webster, "Medical Instrumentation Application and Design", John Willey and Sons, 2006.
4.	Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
5.	Richard Aston "Principles of Biomedical Instrumentation and Measurement", Merril Publishing Company, 1990.
6.	. L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.
7.	John G. Webster, "Bioinstrumentation", John Willey and sons, New York, 2004.
8.	Myer Kutz "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

1902BM602		Analog and Digital Communication	L	T	P	C
			3	0	0	3

Course Objectives:

1. To understand the building blocks of digital communication system.
2. To understand the building blocks of Angle modulation
3. To apply mathematical background for communication signal analysis.
4. To understand and analyze the signal flow in a digital and analog communication system.
5. To analyze error performance of a digital communication system in presence of noise and other interferences

Unit I	AMPLITUDE MODULATION	9 Hours

Introduction to communication system-Need for modulation - Amplitude modulation -Signals and Spectral Analysis of AM, DSB-SC, SSB & VSB- Modulators and transmitters - signal-to- noise ratio (SNR) calculations for amplitude modulation (AM) -Receivers for continuous wave modulation - Super heterodyne Receivers. Digital Multiplexers (TDM,FDM).

Unit II	ANGLE MODULATION	9 Hours

Basic concepts of frequency modulation .single tone frequency modulation, spectrum Analysis of sinusoidal FM wave -Narrow band FM -Wide band FM, Constant Average power Transmission band width of FM wave - comparison of FM and PM-Generation and Detection of FM and PM-Source- Noise, Frequency-domain Representation of Noise ,Superposition of Noises, Linear Filtering of Noise.

Unit III	BASE BAND PULSE TRANSMISSION	9 Hours

Sampling and Quantization process, Binary, M-ary systems, bits and symbols, textual encoding-PCM- Delta Modulation and types, base band pulse transmission, ISI and Nyquist criterion, Generation, Detection, Signal space diagram, bit error probability -Bit error rate(BER),Additive white Gaussian noise (AWGN) and its effects on BER.

Unit IV	PASS BAND PULSE TRANSMISSION	9 Hours

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK– FSK – PSK – QAM).

Unit V	SPREAD SPECTRUM SYSTEMS	9 Hours

Review of digital communication concepts, direct sequence and frequency hop spread spectrum systems. Hybrid direct sequence/frequency hop spread spectrum. Complex envelop representation of spread spectrum signals. Sequence generator fundamentals, Maximum length sequences. Gold and Kasami codes, Nonlinear Code generators. Spread spectrum communication system model, Performance of spread spectrum signals in jamming environments, Performance of spread spectrum communication systems with and without forward error correction. Diversity reception in fading channels, Cellular radio concept

	Total:	45 Hours

Further Reading:

Understand concept of spread spectrum communication system

Course Outcomes:

On successful completion of the course, the student will be able to

1. Describe and analyse the mathematical techniques of generation, transmission and reception of amplitude modulation (AM) , frequency modulation (FM) and phase modulation (PM) signals.
2. Evaluate the performance levels (Signal-to-Noise Ratio) of AM, FM and PM systems

	in the presence of additive white noise.
	3. Convert analog signals to digital format using sampling and quantization techniques.
	4. Describe and analyse the methods of transmission of digital data using baseband and carrier modulation techniques.
	5. Evaluate the performance level (Signal-to-Noise Ratio) of digital data transmission (binary PCM) in the presence of additive white noise.
Text books:	
1. Wayne Tomasi, ―Advanced Electronic Communication Systems‖, 6th Edition, Pearson Education, 2009.	
References:	
1. Principles of Communication Systems – H Taub & D. Schilling, Gautam Sahe. TMH, 2007 III Edition	
2. Principles of Communication Systems - Simon Haykin. John Wiley, II Edition.	
3. John G.Proakis, "Digital Communication" McGraw Hill 3rd Edition, 2008. 6.	
4. Sam K.Shanmugam "Analog & Digital Communication" John Wiley.2006 .	
5. Taub& Schilling, "Principles of Digital Communication " Tata McGraw-Hill" 28th Reprint, 2003.	
6. . Bernard Sklar, "Digital Communication, Fundamental and Application" Pearson Education Asia, 2nd Edition, 2001.	
7. Lathi B.P., "Modern Digital and Communication Systems", Holt and Reinhart Publishers, 1995.	
8. R. L. Peterson, R. E. Zeimer and D. E. Borth, "Introduction to Spread Spectrum Communications", Pearson, 1995	

1902BM603		Biomaterials	L	T	P	C
			3	0	0	3

Course Objectives:	The student should be made to:
	1. To Learn characteristics and classification of Biomaterials
	2. Tio Understand different metals, ceramics and its nanomaterials characteristics as biomaterials
	3. To Learn polymeric materials and its combinations that could be used as a tissue replacement implants
	4. To Get familiarized with the concepts of Nano Science and Technology
	5. To Understand the concept of biocompatibility and the methods for biomaterials testing

Unit I	**INTRODUCTION TO BIO-MATERIALS**	**9 Hours**
Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.		
Unit II	**METALLIC AND CERAMIC MATERIALS**	**9 Hours**
Metallic implants – Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.		
Unit III	**POLYMERIC IMPLANT MATERIALS**	**9 Hours**
Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.		
Unit IV	**TISSUE REPLACEMENT IMPLANTS**	**9 Hours**
Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.		
Unit V	**TESTING OF BIOMATERIALS**	**9 Hours**
Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.		
	Total:	**45 Hours**

Further Reading:	
Biopolymers	
Course Outcomes:	
	At the end of the course, the student should be able to
	1. Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
	2. Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
	3. Identify significant gap required to overcome challenges and further development in polymeric materials
	4. Create combinations of materials that could be used as a tissue replacement implant.
	5. Understand the testing standards applied for biomaterials.

Text books:

1. Sujata V. Bhatt, ―Biomaterials‖, Second Edition, Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo,

―Biomaterials: A Nano Approach‖, CRC Press, 2010

References:

1. Myer Kutz, ―Standard Handbook of Biomedical Engineering & Design‖, McGraw Hill, 2003
2. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, ―Introduction to Biomedical Engineering‖, Elsevier, 2005.
3. Park J.B., ―Biomaterials Science and Engineering‖, Plenum Press, 1984.
4. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,―Woodhead Medical Textiles and Biomaterials for Healthcare‖, Publishing Limited 2006
5. D F Williams, ―Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume‖, VCH Publishers 1992.
6. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. ―Implant biomaterials: A comprehensive review‖, World Journal of Clinical Cases, 2015..

1901HS002	IntellectualPropertyRightsforEngineers	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering. This coursecovers the fundamental aspects of intellectual property (IP): copyright and related rights,trademarks, patents, geographical indications, and industrial designs. It also coverscontemporaryissuesimpactingtheIPfieldsuchas:newplantvarieties,unfaircompetition, enforcement ofIPrightsandemergingissuesinIP.

COURSEOBJECTIVES:

1. AfoundationinthebasicconceptsofIP
2. BetterunderstandingoftherelationshipbetweenIPandotherpolicyareassuchashealth,climatechange,traditional knowledgeandemergingtechnologies
3. Practicallearningexperienceintechnologytransferand IPlicense negotiations
4. Experienceoflearningfromrenownedexpertsinamulticulturalenvironmentand joininganalumniofstudentssharingasimilarinterestinIP
5. Thechancetoidentify areasfor furtherIPstudy

UNITI	Introduction	9 Hours

OverviewofIP,Copyright,Trademarks,GeographicalIndicators,IndustrialDesigns,Patents,Unfaircompetition,Enforcementof IP Rights,EmergingIssues inIP&IPManagement

UNIT II	Copyrights&Trademarks	6 Hours

Theconcept,CaseStudy,Historicalbackground,Principles,NotionofWork,RightsandLimitations,Formats&Filing Procedures

UNIT III	GeographicalIndicators&Industrial Designs	6 Hours

Theconcept,CaseStudy, Historicalbackground,Principles, NotionofWork,Rightsand Limitations,Formats&Filing Procedures

UNIT IV	Patents	15Hours

The Macro-Economic Impact of the Patent System, The Patent Application Process, The DifferentLayersoftheInternationalPatentSystemandRegionalPatentProtectionMechanisms,KindsofIntellectual PropertyProtectionBasedonTypesofInventions,LegalIssuesofthePatentingProcess,Enforcement,New Issues, Important Cases and Discussions, IP and Development - Flexibilities and Public Domain underPatents,PatentSearch

UNIT V	PatentCooperationTreaty	9 Hours

WhatisPCT?UseofPCT,PreparingaPCTApplication,PCTServices,PatentAgentandCommonRepresentatives, InternationalSearch, InternationalExamination

TOTAL:45HOURS

CourseOutcomes:

1. ExplainvarioustypesofIPRsspecifictoEngineering
2. ExplainconceptssuchasCopyrights,Trademarks,GIsandIndustrialdesigns
3. ExplainbasicconceptsofEngineeringPatents
4. ExplainconceptofPatentSearchandvariousmethodstodoit
5. DevelopasamplePCTApplicationandexplainexaminationprocedures

FURTHERREADING:

1. Intellectual PropertyRightsbyPandeyNeeraj&DharniKhushdeep,2014
2. FundamentalsofIPR:forstudents,Industrialistandpatentlawyers,RamakrishnaB&Anil Kumar HS, 2017Drucker

REFERENCES:

1.Lawrelating toIPR byDrMKBandarai,CentralLawPublication,2014

2.IntroductiontoIntellectualPropertyRights,H.S.Chawla,Oxfors& IBHPublishing,2020
3.IntroductiontoIPRbyJPMishra,CentralLawPublications
4.https://patents.google.comIntroductiontoIPRbooks

1903BM006	Bio Analytical methods and Instruments	L	T	P	C
		3	0	0	3
	(For B.E.,BME)				

Course Objectives:	The student should be made to:
	1. To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
	2. To impart fundamental knowledge on gas chromatography and liquid chromatography.
	3. To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
	4. To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
	5. To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I	**SPECTROPHOTOMETRY**	**9 Hours**
Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry – FTIR spectrophotometry – Atomic absorption spectrophotometry – Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.		
UNIT II	**CHROMATOGRAPHY**	**9 Hours**
General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.		
UNIT III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING**	**9 Hours**
Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation – Dust and smoke measurements.		
UNIT IV	**pH METERS AND DISSOLVED COMPONENT ANALYZERS**	**9 Hours**
Selective ion electrodes – Principle of pH and conductivity measurements – dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.		
UNIT V	**NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY**	**9 Hours**
Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.		
	Total:	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
	2.Ability to assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.
	3.Ability to critically evaluate the strengths and limitations of the various instrumental methods.
	4.Ability to develop critical thinking for interpreting analytical data.
	5.Ability to understand the working principle, types and applications of NMR and Mass spectroscopy
Further	

Readings:	
Instrumental Methods of Chemical Analysis	
Text Books:	
1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.	
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006	
References:	
1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd.,2nd Edition 2007.	
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).	
3. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.	

1902BM651		Diagnostic and Therapeutic Equipment Laboratory	L	T	P	C
			0	0	4	2

Course Objectives:	The student should be made to:
	To demonstrate recording and analysis of different Bio potentials
	To analysis of different Bio potentials
	To examine different therapeutic modalities.
	To understand the continuous Signals.
	To Measure various physiological signals

List of Experiments:

1. Measurement of visually evoked potential
2. Galvanic skin resistance (GSR) measurement
3. Study of shortwave and ultrasonic diathermy
4. Measurement of various physiological signals using biotelemetry
5. Study of hemodialysis model 6. Electrical safety measurements
6. Measurement of Respiratory parameters using spirometry.
7. Study of medical stimulator
8. Analyze the working of ESU – cutting and coagulation modes
9. Recording of Audiogram
10. Study the working of Defibrillator and pacemakers
11. Analysis of ECG, EEG and EMG signals
12. Study of ventilators

Additional Experiments:

1. Study of Ultrasound Scanners
2. Study of heart lung machine model

Total:	**45 Hours**

Course Outcomes:	
	Measure different bioelectrical signals using various methods
	Assess different non-electrical parameters using various methodologies
	Illustrate various diagnostic and therapeutic techniques
	Examine the electrical safety measurements
	Analyze the different bio signals using suitable tools.

References:

1. John G. Webster, ―Medical Instrumentation Application and Design‖, 4th edition, Wiley India PvtLtd,New Delhi, 2015
2. Joseph J. Carr and John M. Brown, ―Introduction to Biomedical Equipment Technology‖, Pearson education, 2012.
3. Leslie Cromwell, ―Biomedical Instrumentation and measurement‖, 2nd edition, Prentice hall of India, New Delhi, 2015.
4. Richard Aston ―Principles of Biomedical Instrumentation and Measurement‖, Merril Publishing Company, 1990.
5. L.A Geddas and L.E.Baker ―Principles of Applied Biomedical Instrumentation‖ 2004.
6. Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 3rdedition,Tata McGraw-Hill, New Delhi, 2014.

1902BM652		Analog and Digital Communication Laboratory	L	T	P	C
			0	0	4	2

Course Objectives:	
	1. Understand the basics of analog communication.
	2. Study the different modulators.
	3. Know the noise performance in communication system.
	4. To generate AM and FM using MATLAB
	5. To Examine Pacemaker circuit and industrial Instrumentation Amplifier

List of Experiments:

1. Generation and Demodulation of AM.
2. Generation and Demodulation of FM.
3. FM modulation using PLL.
4. Study of PAM,PWM and PDM
5. Study of FDM and TDM.
6. Generation of AM using MATLAB.
7. Generation of FM using MATLAB.
8. Study of Super heterodyne receiver.
9. Performance analysis of noise in Communication system.
10. Removal of noise in AM and FM.

Additional Experiments:

1. Pace Maker Circuit
2. Industrial Instrumentation amplifier

Total 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Design of AM and FM Circuits.
2. Design of AM and FM Circuits using MATLAB.
3. Determine the different multiplexing technique.
4. Design of Super Heterodyne receiver.
5. Compute the noise performance in communication system.

References:

1. J.G. Proakis, "Digital Communications", McGraw Hill, 5th edition, 2007
2. Simon Haykin, Communication Systems, John Wiley, 2001.
3.Jack Quinn, 'Digital Data Communication", Prentice Hall; 1st edition,-199)
3. P.Michael Fitz, Fundamentals of Communication System, Tata McGraw-Hill -2008.
4. P.Rama Krishna rao, Analog Communication, Tata McGraw-Hill -2011
5. Taub and Schilling, Principles of communication systems, Tata McGraw-Hill, 1995.
6. Bruce Carlson et al, Communication systems, McGraw-Hill,2002.
7. Roddy and Coolen, Electronic communication, PHI, 2003.

1904BM653	MINI PROJECT	L	T	P	C
		0	0	2	1

Course Objectives:

The students should be made to:

1. To develop self-learning skills of utilizing various technical resources to make a technical presentation.
2. To test technical presentation and communication skills.

The students (with team size of 4 students in a team) are expected to make mini project on topics (Preferably in recent trends) related to Biomedical Engineering. A faculty guide is to be allotted if requested and he / she will guide and monitor the progress of the student and maintain attendance also (If no guide is requested then course co coordinator will take care of attendance). Students are encouraged to use various teaching aids such as power point presentation and demonstrative models which should be presented to panel which consist of three faculties (excluding course co coordinator). The average of the mark given by all panel members is taken into consideration.

Evaluation Scheme: Continuous Assessment (100)

Distribution of marks for Continuous Assessment:

ZEROTH REVIEW	10 marks
FIRST REVIEW	20 marks
SECOND REVIEW	20 marks
FINAL REVIEW / DEMO	30 marks
REPORT	20 marks
Total Marks:	**100**

	Total	**30 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Utilize various technical resources available from multiple fields.
2. Improve the technical presentation and communication skills.
3. Connect different domains to make intelligent system.
4. Maximize their technical knowledge with discussing others.
5. Produce different assignments based on real time systems.

1904BM654	INDUSTRIAL VISIT PRESENTATION	L	T	P	C
		0	0	2	1

In order to provide the experiential learning to the students, shall take efforts to arrange at least two industrial visit / field visits in a year. A presentation based on Industrial visits shall be made in this semester and suitable credit may be awarded.

Internal Assessment Only	
Test	40
Presentation / Quiz / Group Discussion	40
Report	20
Grades (Excellent / Good / Satisfactory / Not Satisfactory)	

1904GE651		LIFE SKILLS: APTITUDE - II	L	T	P	C
			0	0	2	1

Course Objectives:

1. To brush up problem solving skill and to improve intellectual skill of the students
2. To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors
3. To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
4. To enhance analytical ability of students
5. To augment logical and critical thinking of Student

Unit I	**Partnership, Mixtures and Allegations, Problem on Ages, Simple Interest, Compound Interest**	**5 Hours**

Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule - Problems on Allegation – Problems on ages - Definitions Simple Interest - Problems on interest and amount - Problems when rate of interest and time period are numerically equal - Definition and formula for amount in compound interest - Difference between simple interest and compound interest for 2 years on the same principle and time period.

Unit II	**Blood relations, , Clocks, Calendars**	**5 Hours**

Defining the various relations among the members of a family - Solving Blood Relation puzzles - Solving the problems on Blood Relations using symbols and notations - Finding the angle when the time is given - Finding the time when the angle is known - Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days - Framing the year code for centuries - Finding the day of any random calendar date .

Unit III	**Time and Distance, Time and Work**	**5 Hours**

Relation between speed, distance and time - Converting kmph into m/s and vice versa - Problems on average speed - Problems on relative speed - Problems on trains - Problems on boats and streams - Problems on circular tracks - Problems on races - Problems on Unitary method - Relation between Men, Days, Hours and Work - Problems on Man-Day-Hours method - Problems on alternate days - Problems on Pipes and Cisterns.

Unit IV	**Data Interpretation and Data Sufficiency**	**5 Hours**

Problems on tabular form - Problems on Line Graphs - Problems on Bar Graphs - Problems on Pie Charts - Different models in Data Sufficiency - Problems on data redundancy

Unit V	**Analytical and Critical Reasoning**	**5 Hours**

Problems on Linear arrangement - Problems on Circular arrangement - Problems on Double line-up - Problems on Selections - Problems on Comparisons - Finding the Implications for compound statements - Finding the Negations for compound statements- Problems on assumption - Problems on conclusions - Problems on inferences - Problems on strengthening and weakening of arguments .

	Total:	**30 Hours**

ASSESSMENT PATTERN :

1. Two tests will be conducted (25 * 2) - 50 marks
2. Five assignments will be conducted (5*10) - 50 Marks

Course Outcomes:

After completion of the course, Student will be able to

1. Solve problems on Partnership, Mixture & Allegation and ages least time using shortcuts and apply real life situations

	2. Workout family relationships concepts, ability to visualize clocks & calendar and understand the logic behind a Sequence.
	3. Calculate concepts of speed, time and distance, understand timely completion using time and work.
	4. Learners should be able to understand various charts and interpreted data least time.
	5. Workout puzzles, ability to arrange things in an orderly fashion.

References:

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
4. R S Agarwal, 'Quantitative Aptitude for Competitive Examinations', revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.