

SEMESTER V									
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CIA	ES	Total	
Theory Course									
1902BM501	Biomedical Equipments	3	0	0	3	40	60	100	PC
1902BM502	Medical Optics	3	0	0	3	40	60	100	PC
1902BM503	Microprocessor and its Applications	3	0	0	3	40	60	100	PC
1902BM504	Biomedical Digital Signal Processing	3	2	0	4	40	60	100	PC
1902BM505	Bio Process Control	3	0	0	3	40	60	100	PC
	Professional Elective - I	3	0	0	3	40	60	100	PE
Laboratory Course									
1902BM551	Biomedical Digital Signal Processing Laboratory	0	0	2	1	50	50	100	PC
1902BM552	Biosensors and Transducers Laboratory	0	0	2	1	50	50	100	PC
1904BM553	Microprocessor and Applications Laboratory	0	0	2	1	50	50	100	PC
1904GE551	Life Skills: Aptitude I	0	0	2	1	100	-	100	EEC
Audit Course									
1901MCX03	Essence of Indian Traditional Knowledge	2	0	0	0	100	0	100	MC
Total		20	2	8	23	490	510	1000	

SEMESTER VI									
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CA	ES	Total	
Theory Course									
1901BM601	Diagnostic and Therapeutic Equipment- I	3	0	0	3	40	60	100	PC
1902BM602	Analog and Digital Communication	3	0	0	3	40	60	100	PC
1902BM603	Biomaterials	3	0	0	3	40	60	100	PC
	Professional Elective - II	3	0	0	3	40	60	100	PE
	HSS Elective	3	0	0	3	40	60	100	HSS
Laboratory Course									
1902BM651	Diagnostic and Therapeutic Equipment Laboratory	0	0	2	1	50	50	100	PC
1902BM652	Analog and Digital Communication Laboratory	0	0	2	1	50	50	100	PC
1902BM653	Mini Project	0	0	2	1	50	50	100	EEC
1902BM654	Industrial Visit Presentation	0	0	2	1	100	-	100	EEC
1904GE651	Life Skills: Aptitude II GD	0	0	2	1	100	0	100	EEC
Total		15	0	10	20	400	400	900	

SEMESTER VII									
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CA	ES	Total	
Theory Course									
1902BM701	Diagnostic and Therapeutic Equipment- II	3	0	0	3	40	60	100	PC
1902BM702	Rehabilitation Engineering	3	0	0	3	40	60	100	PC
	Universal Human values and ethics	3	0	0	3	40	60	100	PC
	Professional Elective - III	3	0	0	3	40	60	100	PE
	Open Elective	3	0	0	3	40	60	100	OE
Laboratory Course									
1902BM751	Hospital Training	0	0	2	1	100	-	100	EEC
1904BM752	In-plant Training/ Internship Presentation	0	0	0	1	100	-	100	EEC
1904GE751	Life Skills : Comprehensive Viva	2	0	0	1	100	-	100	EEC
Total		20	0	2	18	590	410	1000	

SEMESTER VIII									
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CA	ES	Total	
Theory Course									
1902BM801	Radiological Equipment	3	0	0	3	40	60	100	PC
	Professional Elective –IV	3	-	-	3	40	60	100	PE
	Professional Elective –V	3	-	-	3	40	60	100	PE
Laboratory Course									
1904BM851	Project Work	-	-	14	07	50	50	100	EEC
Total		9	-	14	16	170	230	400	
Course Code	Course Name	L	T	P	C	Maximum Marks			Category
						CA	ES	Total	
PROFESSIONAL ELECTIVES – I									
1903BM001	Bio MEMS	3	0	0	3	40	60	100	PE
1903BM002	Nanotechnology in Medicine	3	0	0	3	40	60	100	PE
1903BM003	Bio Signal Processing and Systems	3	0	0	3	40	60	100	PE
1903BM004	Nuclear Medicine	3	0	0	3	40	60	100	PE
PROFESSIONAL ELECTIVES – II									
1903BM005	Regulatory Requirements in Pharmaceutical Industries	3	0	0	3	40	60	100	PE
1903BM006	Bio Analytical methods and Instruments	3	0	0	3	40	60	100	PE
1903BM007	Tele Health Technologies	3	0	0	3	40	60	100	PE
1903BM008	Medical Informatics	3	0	0	3	40	60	100	PE
PROFESSIONAL ELECTIVES – III									

1903BM013	Tissue Engineering and R-DNA technology	3	0	0	3	40	60	100	PE
1903BM014	Medical Imaging	3	0	0	3	40	60	100	PE
1903BM015	Pattern Recognition in Medicine	3	0	0	3	40	60	100	PE
1903BM016	3D Printing Technology	3	0	0	3	40	60	100	PE
PROFESSIONAL ELECTIVES – IV									
1903BM017	Rapid Prototyping	3	0	0	3	40	60	100	PE
1903BM018	Wearable Systems	3	0	0	3	40	60	100	PE
1903BM019	Disaster Managements	3	0	0	3	40	60	100	PE
1903BM020	Special Surgical Equipment	3	0	0	3	40	60	100	PE
PROFESSIONAL ELECTIVES – V									
1903BM021	Biometric Systems	3	0	0	3	40	60	100	PE
1903BM022	Robotics and Medicine	3	0	0	3	40	60	100	PE
1903BM023	Ergonomics	3	0	0	3	40	60	100	PE
1903BM024	Physiological modeling	3	0	0	3	40	60	100	PE
HSS ELECTIVES									
1901HS001	Innovation & Entrepreneurship Fundamendals	3	0	0	3	40	60	100	HSS
1901HS002	Intellectual Property Rights	3	0	0	3	40	60	100	HSS
1901HS003	Start Up Entrepreneurship	3	0	0	3	40	60	100	HSS
1901HS004	Business model Innovation	3	0	0	3	40	60	100	HSS
OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF BIOMEDICAL ENGG									
1903BM009	Biomedical Engineering	3	0	0	3	40	60	100	OE
1903BM010	Design and development of biomedical systems	3	0	0	3	40	60	100	OE
1903BM011	Bio Process Modeling	3	0	0	3	40	60	100	OE
1903BM012	Instrumentation Engineering	3	0	0	3	40	60	100	OE

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

1904GE451	LIFE SKILLS : VERBAL ABILITY	L	T	P	C
		0	0	2	1
COURSE OBJECTIVES:					
<ol style="list-style-type: none"> To help students comprehend and use vocabulary To apply appropriate reading strategies for interpreting technical and non-technical documents used in job-related settings. To ensure students will be able to use targeted grammatical structures meaningfully and appropriately in oral and written production. To enable the students to arrange the sentences in meaningful unit and to determine whether constructions rely on active or passive voice To Apply the principles of effective business writing to hone communication skills 					
MODULE I	VOCABULARY USAGE				6 hours
Introduction - Synonyms and Antonyms based on Technical terms – Single word Substitution – Newspaper, Audio and video listening activity.					
MODULE II	COMPREHENSION ABILITY				
Skimming and Scanning – Social Science passages – Business and Economics passages – latest political and current event based passages – Theme detection – Deriving conclusion from passages					
MODULE III	BASIC GRAMMAR AND ERROR DETECTION				6 hours
Parallelism – Redundancy – Ambiguity – Concord - Common Errors – Spotting Errors – Sentence improvement – Error Detection FAQ in Competitive exams.					
MODULE IV	REARRANGEMENT AND GENERAL USAGE				6 hours
Jumble Sentences – Cloze Test - Idioms and Phrases – Active and passive voice – Spelling test.					
MODULE V	APPLICATION OF VERBAL ABILITY				6 hours
Business Writing - Business Vocabulary - Delivering Good / Bad News - Media Communication - Email Etiquette – Report Writing - Proposal writing – Essay writing– Indexing –Market surveying.					
					TOTAL: 30 HOURS
COURSE OUTCOMES					
CO1	Construct new words in their day to day communication.				
CO2	Predict the information swiftly while reading passages.				
CO3	Elaborate their oral and written communication.				
CO4	Rephrase the sentences and able to identify the voice of the sentence.				
CO5	Summarize their knowledge of the best practices to craft effective business documents				
CO6	Make use of the etiquette in business.				
REFERENCES:					
1. Arun Sharma and Meenakshi Upadhyay, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition 2017					
2. R S Aggarwal and Vikas Aggarwal , Quick Learning Objective General English ,S.Chand Publishing House, 2017					
3. Dr.K.Alex , Soft Skills, S.Chand Publishing House, Third Revise Edition, 2014					
4. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition , 2007					

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

		Bio MEMS	L	T	P	C
			3	2	0	4
Course Objectives:	The student should be made to:					
	1. Learn various MEMS fabrication techniques.					
	2. Understand different types of sensors and actuators and their principles of operation at the micro scale level.					
	3. Know the application of MEMS in different field of medicine					
Unit I	MEMS MATERIALS AND FABRICATION				12 Hours	
Typical MEMS and Microsystems, materials for MEMS – active substrate materials-Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.						
Unit II	MECHANICAL AND THERMAL SENSORS AND ACTUATORS				12 Hours	
mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor						
Unit III	ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS				12 Hours	
sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.						
Unit IV	MICROFLUIDIC SYSTEMS				12 Hours	
Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers						
Unit V	APPLICATIONS OF BIOMEMS				12 Hours	
CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor.						
					Total:	45+15 Hours
Further Readings:	Bio techniques using microtechnology, Shrinking Technologies					
Course Outcomes:	At the end of the course, the student should be able to:					
	After completion of the course, Student will be able to					
	1. Discuss various MEMS fabrication techniques.					
	2. Explain different types of sensors and actuators and their principles of operation at the micro Scale level.					
	3. Apply MEMS in different field of medicine.					
References:	1. Tai Ran Hsu, —MEMS and Microsystems Design and Manufacture, Tata McGraw Hill Publishing Company, New Delhi, 2002. (Unit I, II, III & IV).					
	2. Wanjun Wang, Stephen A.Soper, BioMEMS: Technologies and Applications , CRC Press, New York, 2007.(Unit V).					
Text Books:	1. Marc J. Madou —Fundamentals of Microfabrication: the Science of Miniaturization , CRC Press,2002					
	2. Nadim Maluf, Kirt Williams. —An introduction to Microelectro Mechanical Systems Engineering , Second Edition, Artech House Inc, MA, 2004.					
	3. Chang Liu, ' Foundations of MEMS', Pearson Education International, New Jersey, USA,2006					
	4. Nitaigour Premchand Mahalik, —MEMS , Tata McGraw Hill Publishing Company, New Delhi, 2007					

Professional Elective I (PE)

1903BM002	Nanotechnology in Medicine			L	T	P	C
				3	0	0	3
	(For B.E.,BME)						
Course Objectives:	The student should be made to:						
	1. To Learn various concepts of nanomedicine.						
	2. To Understand nanobiomaterials and its biocompatibility						
	3. To Know principles of bio nanotechnology and nanostructures.						
	4. To Discuss about protein and DNA based Nano Structure						
	5. To Describe the Nano Bio Analytics.						
UNIT I	Introduction					9 Hours	
Introduction and Rationale for Nanotechnology in Cancer Therapy - Passive Targeting of Solid Tumors: Pathophysiological Principles and Physicochemical Aspects of Delivery Systems - Active Targeting Strategies in Cancer with a Focus on Potential Nanotechnology Applications Nanobiotechnology in Drug Delivery –Nanoscale Delivery of Therapeutics – Nano suspension Formulations Viruses as Nanomaterials for Drug Delivery							
UNIT II	Nanobiomaterials And Biocompatibility					9 Hours	
Surface and Bulk Properties of Bio materials – Nanobiomaterials – NanoCeramics – Nanopolymers – Nano Silica – Hydroxy apatite – Carbon Based nanomaterials Surface modification – Textured and Porous Materials – Surface immobilized biomolecules – Cell-biomaterial interactions – immune response – In Vitro and In Vivo assessment of tissue compatibility							
UNIT III	Structural & Functional Principles Of Bio Nano technology					9 Hours	
liposomes – neosomes-Phytosomes, Polysaccharides – Peptides –Nucleic acids – DNA scaffolds – Enzymes- Biomolecular motors: linear, rotary motors – Immunotoxins – Membrane transporters and pumps – Antibodies – monoclonal Antibodies – immunoconjugates – limitations of natural biomolecules							
UNIT IV	Protein And DNA Based Nanostructures					9 Hours	
structure, chemistry and assembly – lipid chips – S – Layers as Templates – engineered nanopores – DNA–Protein Nanostructures DNA-based Metallic Nanowires and Networks, DNA–Gold–Nanoparticle Conjugates							
UNIT V	Nano Bio-Analytics					9 Hours	
Luminescent Quantum Dots for Biological Labeling – Nanoparticle Molecular Labels – Surface Biology: Analysis of Biomolecular Structure by Atomic Force Microscopy and Molecular Pulling – Force Spectroscopy – Biofunctionalized Nanoparticles for Surface – Enhanced Raman Scattering and Surface Plasmon Resonance – Bioconjugated Silica Nanoparticles for Bioanalytical Applications							
						Total:	45 Hours
Further Readings:	Nanorobots in Medicine, Nanoparticles in Medicine						
Course Outcomes:	After completion of the course, Student will be able to						
	1. Understand the Basics of Nanobiotechnology in Relation to Nanomedicine						
	2. Understand Nano biomaterials and its biocompatibility						
	3. Know principles of bio nanotechnology and nano structures.						
	4. . Discuss about protein and DNA based Nano Structure						
	5. Describe the Nano Bio Analytics						
Text Books:							
	1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.(Unit I – V)						
	2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)						
References:							

1. Molecular Cell Biology,Harvey Lodish, Published by W.H. Freeman & Company
2. Biomaterials: A Nano Approach,S Ramakrishna, M Ramalingam, T.S. Sampath Kumar, Winston O. Soboyejo,Published by CRC Press
3. Bionanotechnology: Lessons from Nature, D S. Goodsell, by John Wiley & Sons, Inc
4. Nanobiotechnology: Concepts, Applications and Perspectives,(edited by C. M. Niemeyer and C. A. Mirkin), Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim,
5. Nanobiotechnology: Concepts, Applications and Perspectives,Edited by Christof M. Niemeyer and Chad A. Mirkin, Wiley-VCH, 2004,ISBN 3527306587

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

1904GE551	LIFE SKILLS: APTITUDE - I	L	T	P	C
		0	0	2	1
Course Objectives:					
<ol style="list-style-type: none"> To brush up problem solving skill and to improve intellectual skill of the students To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions. To enhance analytical ability of students To augment logical and critical thinking of Student 					
UNIT I	INTRODUCTION TO NUMBER SYSTEM, BASIC SHORTCUTS OF ADDITION, MULTIPLICATION, DIVISION	5 Hours			
Classification of numbers – Types of Numbers - Divisibility rules - Finding the units digit - Finding remainders in divisions involving higher powers - LCM and HCF Models - Fractions and Digits – Square, Square roots – Cube, Cube roots – Shortcuts of addition, multiplication, Division.					
UNIT II	RATIO AND PROPORTION, AVERAGES	5 Hours			
Definition of Ratio - Properties of Ratios - Comparison of Ratios - Problems on Ratios - Compound Ratio - Problems on Proportion, Mean proportional and Continued Proportion Definition of Average - Rules of Average - Problems on Average - Problems on Weighted Average - Finding average using assumed mean method.					
UNIT III	PERCENTAGES, PROFIT AND LOSS	5 Hours			
Introduction Percentage - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions - Problems on percentages - Problems on Profit and Loss percentage-Relation between Cost Price and Selling price - Discount and Marked Price - Two different articles sold at same Cost Price - Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price.					
UNIT IV	CODING AND DECODING, DIRECTION SENSE	5 Hours			
Coding using same set of letters - Coding using different set of letters - Coding into a number - Problems on R-model - Solving problems by drawing the paths - Finding the net distance travelled - Finding the direction - Problems on clocks - Problems on shadows - Problems on direction sense using symbols and notations.					
UNIT V	NUMBER AND LETTER SERIES NUMBER AND LETTER ANALOGIES, ODD MAN OUT	5 Hours			

Difference series - Product series - Squares series - Cubes series - Alternate series - Combination series - Miscellaneous series - Place values of letters - Definition of Analogy - Problems on number analogy - Problems on letter analogy - Problems on verbal analogy - Problems on number Odd man out - Problems on letter Odd man out - Problems on verbal Odd man out

	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. Learners should be able to understand number and solving problems least time using various shortcut
2. Solve problems on averages; compare two quantities using ratio and proportion.
3. Calculate concept of percentages, implement business transactions using profit and loss.
4. Workout concepts of Coding and Decoding, ability to visualize directions and understand the logic behind a sequence.
5. Learners should be able to find a series the logic behind a sequence.

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 Indu Sijwali, “A New Approach to REASONING Verbal & Non-Verbal”, 2nd edition, Arihant publication, 2014.

Professional Elective – II (PE)

BIO ANALYTICAL METHODS AND INSTRUMENTATION		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, NO ₂ and H ₂ S 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.				

1901HS003	STARTUP ENTREPRENEURSHIP	L	T	P	E
PREREQUISITE:					
	The course assumes no prior skill or background in design, art, engineering, or science. It is open to all undergraduates and graduate students with an interest in learning Entrepreneurship, and is especially recommended for those students planning venture creation and other kinds of entrepreneurial interventions.				
COURSE OBJECTIVES:					
	<ol style="list-style-type: none"> 1. Understand the terminology and conceptual of Entrepreneurship & Startups 2. Understand real time problem solving methodologies with tools 3. Recognize the ethical and social dilemmas and obligations of the practice of design of solutions 4. Diagnose common adoption barriers in individuals, groups and organizations. 5. Develop a design theory from independent and qualitative research and observations 6. Participate in and lead innovation in creative and collaborative settings 7. Undertake complex and unstructured problem-solving challenges in unfamiliar domains 				
COURSE OUTCOME					
CO1	Detail Entrepreneurship and Startup Basics				
CO2	Employ the methods and tools of Problem Solving in business context				
CO3	Project Startup Idea Development Process and Methodologies through Real Problem Solving				
CO4	Develop Startup Prototype through Customer Validation and Business Models				
CO5	Explain Intellectual Property Rights and its importance in business context				
Module I	Entrepreneurship & Startup Basics				5 Hours
Entrepreneurship basics – Skill Set, Mindset, Examples, Startup basics overview, Indian Startup Ecosystem, Problems – Identification, Selection, Evaluation, Validation, Teaming					
Module II	Customer Discovery Process				7 Hours
Customer Discovery Process, Opportunity Identification, Evaluating Opportunities, Customer discovery with at least 15 interviews. Results presentation and hypothesis refinement. Focus on customer segments of the business model canvas.					
Module III	Ideation				5 Hours
Ideation – Brainstorming, Technology driven Ideation, Continued customer discovery and updates to hypothesis. Focus on value proposition of business model canvas.					
Module IV	Market Analysis				6 Hours
Market Analysis – Perform market research, Competitive advantage landscape, Market Size, Go-To Market Strategies, Continued customer discovery and updates to hypothesis. Focus on channels of business model canvas.					
Mid-term presentation on startup idea, refined hypothesis through customer discovery					
Module V	Minimum Viable Product				5 Hours
Minimum Viable Product/Validation: Product market fit, use customer discovery in defining the MVP, Build Proof Of Concepts for specific customer use-cases. Focus on metrics of business model canvas.					
Module VI	Business Models				7 Hours
Business Models/Metrics – Chosen business model for the venture, Focus on key resources/activities of business model canvas. Start customer validation phase.					
Module VII	Pivoting				3 Hours
Pivoting - Pivot product and business models based on customer discovery and validation, Choose pivot direction. Focus on cost structures and partners of business model canvas. Continued customer validation.					
Mid-term presentation on startup prototype, preliminary results from customer validation, prototype refinements and plan.					
Module VIII	IP/Legal				4 Hours
IP/Legal: Importance of IP, Protect IP, Licensing IP, IP based Entrepreneurship; Examples, Continued customer validation.					
Module IX	Capital				3 Hours
Capital: Capital requirement for the venture, Raising capital & increments, Continued customer validation. Liquidity/Exit: Liquidity events, Trade-offs					
Final presentations of startup idea, refined prototype, customer validation, and future plans					
TOTAL: 45 HOURS					
FURTHER READING:					
	<ol style="list-style-type: none"> 1. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company by Steve Blank 2. Value Proposition Design: How to Create Products and Services Customers Want (Strategyzer) by Alexander Osterwalder 3. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers by Alexander Osterwalder 				

4. The Four Steps to the Epiphany, Steven Blank

REFERENCES:

1. Creative Confidence: Unleashing the Creative Potential Within Us All Book by David M. Kelley and Tom Kelley, 2013

2. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009

3. The art of Innovation by Tom Kelly, 2011

4. Design Thinking for Strategic Innovation: What They Can't Teach You at Business Or Design School Book by IdrisMootee, 2013

5. The Design of Everyday Things Book by Don Norman, 1988

6. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems Book by Michael Lewrick, 2017.

7. <https://nptel.ac.in/courses/109104109/>**Employability Enhanced Course Project Seminar Internship (EEE / PSI)**

1904BM653	MINI PROJECT				L	T	P	C
					0	0	2	1
Course Objectives:	The students should be made to:							
	<ol style="list-style-type: none"> To develop self-learning skills of utilizing various technical resources to make a technical presentation. To test technical presentation and communication skills. 							
<p>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.</p>								
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								
<ol style="list-style-type: none"> Utilize various technical resources available from multiple fields. Improve the technical presentation and communication skills. Connect different domains to make intelligent system. Maximize their technical knowledge with discussing others. Produce different assignments based on real time systems. 								

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

1904BM654	INDUSTRIAL VISIT PRESENTATION	L	T	P	C										
		0	0	2	1										
<p>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.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Internal Assessment Only</th> </tr> </thead> <tbody> <tr> <td>Test</td> <td style="text-align: right;">40</td> </tr> <tr> <td>Presentation / Quiz / Group Discussion</td> <td style="text-align: right;">40</td> </tr> <tr> <td>Report</td> <td style="text-align: right;">20</td> </tr> <tr> <td colspan="2">Grades (Excellent / Good / Satisfactory / Not Satisfactory)</td> </tr> </tbody> </table>						Internal Assessment Only		Test	40	Presentation / Quiz / Group Discussion	40	Report	20	Grades (Excellent / Good / Satisfactory / Not Satisfactory)	
Internal Assessment Only															
Test	40														
Presentation / Quiz / Group Discussion	40														
Report	20														
Grades (Excellent / Good / Satisfactory / Not Satisfactory)															

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

1904GE651	LIFE SKILLS: APTITUDE - II	L	T	P	C
		0	0	2	1
Course Objectives:					
<ol style="list-style-type: none"> 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', 7 th edition, McGraw Hills publication, 2016.
	2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4 th 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", 3 rd edition, Arihant publication, 2018.
	6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2 nd edition, Arihant publication, 2014.

Professional Elective - III

1903BM014		Medical Imaging	L	T	P	C
			3	0	0	3
		(For B.E.,BME)				
Course Objectives:	The student should be made to:					
	1. To study the formation of an image and its acquisition					
	2. To introduce the use and application of transforms in image processing					
	3. To study techniques for image segmentation in corrupted images					
	4. To learn for medical image extraction and selection.					
	5. To introduce schemes for compressing images to save storage space					
UNIT I	DIGITAL IMAGE FUNDAMENTALS					9 Hours
Elements of digital image processing systems - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, Two- dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD.						
UNIT II	IMAGE ENHANCEMENT AND RESTORATION					9 Hours
Point processing, Histograms, Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic mean filters, Homomorphic filtering, Color image enhancement. Image Restoration - degradation model, Unconstrained and Constrained restoration .Geometric transformations.						
UNIT III	IMAGE SEGMENTATION					9 Hours

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Segmentation by morphological watersheds – Hybrid methods		
UNIT IV	IMAGE FEATURE EXTRACTION AND SELECTION	9 Hours
Features- Feature space, Statistical features, Texture features-co-occurrence features and Run length features, shape features. Feature selection – Need-PCA, statistical analysis and selection of features.		
UNIT V	IMAGE COMPRESSION	9 Hours
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.		
		Total: 45 Hours
Course Outcomes:		
	After completion of the course, Student will be able to	
	1. Process color images and compute image transforms..	
	2. Preprocess the image using image enhancement and filtering techniques.	
	3. Restore the degraded images.	
	4. Explain the Segment the region of interest in images.	
	5. Apply various compression techniques on images.	
Further Readings:	Image Modelling	
Germany Weighs Biometric Registration Options for Visa Applicants		
Text Books:		
1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson, Education, Inc., 4th Edition, 2017		
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, Inc., 1st Edition, 2015		
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine vision”, Cengage, 3rd Edition, 2013.		
References:		
1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 1st Edition, 2007.		
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Pearson Education, Inc., 2nd Edition, 2017.		
3. William K. Pratt, “Digital Image Processing” ,Wiley India Pvt Ltd, 4th Edition, 2010.		
4. Alan C. Bovik, “Handbook of image and video processing”, Elsevier Academic press, 2005		
5. S.Sridhar, “Digital Image processing”, Oxford University press, 2ndEdition, 2016		

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

1904GE751	LIFE SKILLS: COMPREHENSIVE VIVA	L	T	P	C
		2	0	0	2
Course Objectives:					
1. Study the concepts of data structures, algorithms and computer architecture.					
2. Study the process and implementation of Operating systems and design of compilers.					
3. Familiar with the database and network concepts					
Data Structures: Recursion. Arrays, Stacks, Queues, Linked lists, Trees, Graphs					
Algorithms: Searching – Sorting - Asymptotic worst case time and space complexity – Greedy – Divide & Conquer – Dynamic Programming					
Computer Organization: Machine instructions - Addressing modes - Hazards – Pipelining – Memory hierarchy - I/O interface					
Operating System: Processes – Threads - Inter-process communication - Concurrency and synchronization – Deadlock - CPU scheduling - Memory management and virtual memory - File systems					
Databases: ER-model - Relational model: Relational algebra, Tuple Calculus - SQL - Integrity constraints - Normal forms -Transactions and concurrency control					
Computer Networks: Layering – Categories – Topology - Flow and Error control techniques – Switching - IPv4/IPv6 - Routing - TCP – UDP - Application layer protocols – Bluetooth - Wi-Fi - Network security – Firewalls - Digital signatures and certificates.					

Compiler Design: Theory of Computation - Lexical analysis, parsing, syntax directed translation - Runtime environments - Intermediate code generation	
TOTAL	30 Hours
COURSE OUTCOMES: At the end of this course, students will able to, CO1: Explore the concepts of data structures, algorithms and computer architecture. CO2: Elucidate the concepts of operating systems and designing compilers. CO3: Explain the concepts of networks and manage databases	
REFERENCES: 1. M.A.Weiss, Data Structures and Algorithm Analysis in C, Pearson Education Asia, 2015. 2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, McGraw-Hill, Third Reprint 2015. 3. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Principles", John Wiley & Sons (Asia) Pvt. Ltd, Ninth Edition, 2013. 4. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman Compilers: Principles, Techniques and Tools , 2nd Edition, Pearson, 2012. 5. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts , McGraw -Hill, 2015. 6. Behrouz A.Forouzan, Data Communication and Networking, 5th Edition, Tata McGraw-Hill, 2014.	
ASSESSMENT PATTERN : Marks (Continuous Assessment Only) Test I 25 Test II 25 Final Examination 50 Total Marks 100	

Employability Enhanced Course Project Seminar Internship (EEE / PSI)

1903BM012	INSTRUMENTATION ENGINEERING			L	T	P	C
				3	0	0	3
Course Objectives:							
	1. To understand the basics of Instruments. 2. To understand the Transducers. 3. To understand the Electrical and Electronic Instruments 4. To understand about basics of amplifier. 5. To apply the measuring data to measuring system.						
Unit I	INTRODUCTION			9 Hours			
Fundamental elements of an instrument – Static and Dynamic Characteristics – Errors in Instruments – Statistical evaluation of measurement data – Calibration							
Unit II	Transducer			9 Hours			
Definition – Classification of transducer – Selection of transducer – Resistance, Capacitance & Inductive transducer – Piezo electric transducer – Magnetostrictive Transducer.							
Unit III	Electrical & Electronic Instruments			9 Hours			
Ammeter, Voltmeter, Moving Coil and Moving Iron Instruments- DC & AC Potentiometer - DC & AC bridges- CRT display – Digital CRO –LED – LCD & Dot matrix display.							
Unit IV	Amplifier			9 Hours			
Inverting and Non inverting Amplifier – Differential Amplifier – Instrumentation amplifier							
Unit V	Data Acquisition System and Applications			9 Hours			
Elements of Data acquisition system, A/D and D/A converters.- SCADA – DCS, SMART Transducer.							
			Total:	45 Hours			
Further Reading:	Biomedical Instrumentation						
Course Outcomes:							
	Upon successful completion of this course, students will be able to:						
	1. Explain the measuring fundamentals.						
	2. Illustrate the principle of Transducer.						
	3. Interpret the technique used for electrical and electronic measurements						
	4. Demonstrate the amplifiers						
	5. Outline the methods of Data acquisition system.						
Text books:							
1. Hand Books on Fundamentals of Electrical and Electronic measurements by A.K. Shawni							
2. .Measurement system by Doebelin							
References:							
1. Electronic Measurements by H.S Kalsi							
2. Measurements and Instrumentation by uday Bakshi							

OBJECTIVES: The student should be made to

- Observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- Provide access to healthcare Professionals to get a better understanding of their work; □
Demonstrate patient-care in a hospital setting.

ASSESSMENT:

- Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course incharges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

S.No.	Departments for visit
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopaedic and Physiotherapy
5	ICU/CCU
6	Operation Theatre
7	Neurology
8	Nephrology
9	Radiology
10	Nuclear Medicine
11	Pulmonology
12	Urology
13	Obstetrics and Gynaecology
14	Emergency Medicine
15	Biomedical Engineering Department
16	Histo Pathology
17	Biochemistry
18	Paediatric/Neonatal
19	Dental
20	Oncology
21	PAC's
22	Medical Records / Telemetry

TOTAL : 15 PERIODS**OUTCOMES:****At the end of the course, the student should be able to:**

- Advocate a patient-centred approach in healthcare

- Communicate with other health professionals in a respectful and responsible manner
Recognize the importance of inter-professional collaboration in healthcare.
- Propose a patient-centred inter-professional health improvement plan based upon the patient’s perceived needs
- Use the knowledge of one’s own role and those of other professions to address the healthcare needs of populations and patients served.

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1904BM752	In-plant Training/ Internship Presentation	L T P C
		0 0 0 1

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Course Objectives:

- | |
|--|
| <ul style="list-style-type: none"> • To provide hands-on experience at site where biomedical equipment are manufactured and utilized (Hospitals). |
|--|

Course outcomes:

- | |
|---|
| 1. Learner will be able to gather a first hand experience on usage of various biomedical equipment. |
| 2. Learner will be able to get familiar with various medical imaging techniques. |
| 3. Learner will be able to gain some practical experience in servicing the equipment. |

INDUSTRIAL TRAINING III

Students have to undergo two weeks practical training in biomedical equipment manufacturing companies or hospitals. At the end of the training student will submit a report as per the prescribed format to the department.

1904BM851 PROJECT WORK

L T P C

0 0 14 07

OBJECTIVES:

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:

On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.