ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. BIOMEDICAL ENGINEERING
REGULATIONS – 2019

VISION

The Department of ECE shall strive continuously to create highly motivated, technologically competent engineers, be a benchmark and a trend setter in Electronics and Communication Engineering by imparting quality education with interwoven input from academic institutions, research organizations and industries, keeping in phase with rapidly changing technologies imbibing ethical values.

MISSION

- Imparting quality technical education through flexible student centric curriculum evolved continuously for students of ECE with diverse backgrounds.

- Providing good academic ambience by adopting best teaching and learning practices.

- Providing congenial ambience in inculcating critical thinking with a quest for creativity, innovation, research and development activities.

- Enhancing collaborative activities with academia, research institutions and industries by nurturing ethical entrepreneurship and leadership qualities.

- Nurturing continuous learning in the stat-of-the-art technologies and global outreach programmes resulting in competent world class engineers.

Attested

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B.E. BIO MEDICAL ENGINEERING

The programme spells out Programme Educational Objectives (6 PEOs), Programme Outcomes (12 POs) with mapping and Program Specific Outcomes (4 PSOs)

1. **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**
    THE OBJECTIVES OF THE B.E BIO MEDICAL ENGINEERING PROGRAMME IS BROADLY DEFINED ON THE FOLLOWING:

    I.   Prepare the students to comprehend the fundamental concepts in Bio Medical Engineering.
    II.   Enable the students to relate theory with practice for problem solving.
    III. Enable the students to critically analyse the present trends and learn and understand future issues.
    IV.   Motivate the students to continue to pursue lifelong learning as professional engineers and scientists and effectively communicate.
    V.   The technical details and to work effectively in teams of multidisciplinary nature and to apply Bio Medical Engineering solutions to the society.
    VI.   Enhance the capability of the students to analyse existing healthcare systems in general and also in specific areas to find innovative and cost-effective solutions to the healthcare industry and hence may lead to entrepreneurial initiatives.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Biomedical Engineering Graduates will exhibit ability to:

PO#	GRADUATE ATTRIBUTE	PROGRAMME OUTCOME
1.	Engineering knowledge	Apply life science, engineering and mathematical concepts in modeling and design of biomedical systems of varying complexity.
2.	Problem analysis	Critically analyse a problem, identify and formulate solution in the field of Bio Medical Engineering taking into consideration the current trends and future issues.
3.	Design/development of solutions	Critically analyse the current healthcare systems and design components, systems or process based innovative solutions in the field of Bio Medical Engineering to meet the needs within realistic constraints such as economic, safety and sustainability
4.	Conduct investigations of complex problems	Create Problem specific designs and arrive at point care solutions based on actual research outcomes.
5.	Modern tool usage	Gather hands-on knowledge on cutting edge hardware and software tools to acquire real time data, model and simulate physiological processes and analyze limitations on real time implementations.
6.	The engineer and society	Analyse the impact of healthcare delivery on individuals and society and develop professional responsibilities concerned with legal aspects.
7.	Environment and sustainability	Understand the necessity for environmental friendly biomedical engineering solutions and evaluate its sustainability across diverse scenarios.
8.	Ethics	Develop knowledge on ethical principles and work towards the implementation of ethically committed Biomedical engineering practices.

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9.	Individual and team work	Work effectively in teams of multidisciplinary nature to accomplish a goal
10.	Communication	Communicate efficiently to an audience of multidisciplinary nature and to prepare technical documents and to present effectively
11.	Project management and finance	Ability to understand and comprehend the engineering and managerial principles to manage projects individually or as a team.
12.	Life-long Learning	Understand the need and possess the ability for lifelong learning to have continuous professional development

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Bio Medical Engineering program, the student will have following Program Specific Outcomes.

1.	Foundation	Graduates will have a strong foundation in Life Science, engineering, mathematics and current biomedical engineering practices with an ability to demonstrate advanced knowledge of a selected area within Bio Medical Engineering.
2.	Communication	Graduates will be given a platform to develop their overall communication and inter personal skills with exposure to team-building activities that are multi – disciplinary in nature.
3.	Responsibility.	Graduates will acknowledge their ethical, legal and professional responsibilities as a biomedical engineer to develop human, societal and environmental friendly sustainable solutions.
4.	Design.	Graduates will be able to critically analyse the current healthcare systems and develop innovative solutions effectively through problem specific design and development using modern hardware and software tools.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVE WITH PROGRAMME OUTCOMES

A broad relation between the programme objectives and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I.	✓	✓	✓	✓	✓							
II.	✓	✓	✓	✓	✓		✓					
III.		✓	✓	✓			✓				✓	✓
IV.			✓	✓	✓					✓		✓
V.		✓	✓	✓	✓	✓	✓	✓	✓		✓	
VI.			✓	✓	✓			✓	✓		✓	✓

		COURSE NAME	PROGRAMME OUTCOMES											
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
YEAR 1	SEMESTER 1	Technical English												
		Engineering Mathematics I												
		Engineering Physics												
		Engineering Chemistry												
		Problem Solving and Python Programming	✓	✓	✓	✓	✓			✓	✓			✓
		Basic Sciences Laboratory												
		Problem Solving and Python Programming Lab	✓	✓	✓	✓	✓			✓	✓			✓
	SEMESTER 2	Professional Communication												
		Engineering Mathematics II												
		Engineering Mechanics	√		√									√
		Basics of Electrical and Electronics Engineering												
		Circuit Theory	√	√	√	√	√	√			√			√
		Anatomy and Physiology	√	√	√	√				√		√		√
		Electrical and Electronics Engineering Lab	√	√	√		√							√
		Workshop Practices Laboratory	√	√	√	√								
YEAR 2	SEMESTER 3	Transform Techniques and Partial Differential Equations	√	√	√	√						√		
		Electives – Humanities I												
		Sensors and Measurements	√	√	√	√	√	√	√	√				√
		Java Programming	√	√	√	√	√				√	√		√
		Electron Devices and Circuits	√	√	√									√

Year	Semester	Course	1	2	3	4	5	6	7	8	9	10	11	12
		Devices and Circuits Laboratory	√	√	√	√	√				√	√		√
		Sensors and Measurements Laboratory	√	√	√	√	√	√	√	√	√	√		√
	SEMESTER 4	Fundamentals of Biochemistry	√	√		√						√		√
		Analog and Digital Integrated Circuits	√	√		√		√	√	√		√		√
		Environmental Sciences	√					√	√	√				√
		Control System for Biomedical Engineering	√	√	√	√		√	√	√	√			√
		Biomedical Instrumentation	√	√	√	√	√	√	√	√				√
		Electives – Humanities II		√	√	√		√	√		√	√	√	
		Biochemistry and Human Physiology Laboratory	√	√	√			√	√	√	√	√		
		Analog and Digital Integrated Circuits Laboratory	√	√	√	√					√	√		
		Audit Course I												
YEAR 3	SEMESTER 5	Diagnostic and Therapeutic Equipment I	√	√		√	√	√	√	√				√
		Discrete Time Signal Processing	√	√	√	√	√							√
		Pathology and Microbiology	√	√		√								√
		Hospital Management				√								
		Audit Course II				√								
		Professional Elective I												
		Digital Signal Processing Laboratory	√	√		√	√					√		√
		Biomedical Instrumentation Laboratory		√		√	√	√	√	√	√			

Year	Semester	Course													
	SEMESTER 6	Summer Internship / Summer Project (Minimum 4 weeks)													
		Diagnostic and Therapeutic Equipment II	√	√		√	√	√	√	√			√		√
		Radiological Equipment	√	√	√	√		√	√	√					√
		Microprocessors and Microcontrollers	√	√	√	√	√								√
		Professional Elective II													
		Professional Elective III													
		Open Elective I													
		Diagnostic and Therapeutic Equipment Laboratory	√	√		√	√	√	√	√					
		Microcontroller and Interfacing Laboratory	√	√	√	√	√					√	√		√
YEAR 4	SEMESTER 7	Bio Mechanics	√	√	√	√	√	√	√	√	√				√
		Principles of Digital Image Processing	√	√		√	√	√	√				√		√
		Professional Elective IV													
		Professional Elective V													
		Open Elective II													
		Medical Image Processing Laboratory	√	√		√	√	√	√			√	√		√
		Hospital Training													
		Project – I													
	SEMESTER 8														
		Professional Elective VI													
		Professional Elective VII													
		Project – II													

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REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI FOR I - VIII SEMESTER

SEMESTER I

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5153	Problem Solving and Python programming	ESC	3	0	0	3	3
PRACTICALS								
6.	GE5161	Problem Solving and Python programming Laboratory	ESC	0	0	4	4	2
7.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
			TOTAL PERIODS	16	1	8	25	21

SEMESTER II

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	HS5251	Professional Communication	HSMC	4	0	0	4	4
2.	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
3.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
4.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
5.	EC5251	Circuit Theory	ESC	3	1	0	4	4
6.	BM5201	Anatomy and Physiology	BSC	3	0	0	3	3
PRACTICALS								
7.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
8.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
			TOTAL PERIODS	19	3	8	30	26

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SEMESTER III

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	MA5355	Transform Techniques and Partial Differential Equations	BSC	3	1	0	4	4
2.	BM5301	Sensors and Measurements	PCC	3	0	0	3	3
3.	BM5302	Java Programming	ESC	2	0	2	4	3
4.	EC5305	Electronic Devices and Circuits	PCC	3	0	0	3	3
5.		Electives – Humanities I	HSMC	3	0	0	3	3
PRACTICALS								
6.	EC5312	Devices and Circuits Laboratory	PCC	0	0	4	4	2
7.	BM5311	Sensors and Measurements Laboratory	PCC	0	0	4	4	2
			TOTAL PERIODS	14	1	10	25	20

SEMESTER IV

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	BM5401	Fundamentals of Biochemistry	PCC	3	0	0	3	3
2.	EC5406	Analog and Digital Integrated Circuits	PCC	3	0	0	3	3
3.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
4.	BM5402	Control System for Biomedical Engineering	PCC	3	0	0	3	3
5.	BM5403	Biomedical Instrumentation	PCC	3	0	0	3	3
6.		Electives – Humanities II	HSMC	3	0	0	3	3
7.		Audit Course I *	AC	3	0	0	3	0
PRACTICALS								
8.	BM5411	Biochemistry and Human Physiology Laboratory	PCC	0	0	4	4	2
9.	EC5413	Analog and Digital Integrated Circuits laboratory	PCC	0	0	4	4	2
			TOTAL PERIODS	21	0	8	29	22

*Audit Course is optional

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SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	BM5501	Diagnostic and Therapeutic Equipment I	PCC	3	0	0	3	3
2.	BM5502	Discrete Time Signal Processing	PCC	3	0	0	3	3
3.	BM5503	Pathology and Microbiology	PCC	2	0	2	4	3
4.	HM5404	Hospital Management	HSMC	3	0	0	3	3
5.		Audit Course II*	AC	3	0	0	3	-
6.		Professional Elective I	PEC	3	0	0	3	3
PRACTICALS								
7.	BM5511	Digital Signal Processing Laboratory	PCC	0	0	4	4	2
8.	BM5512	Biomedical Instrumentation Laboratory	PCC	0	0	4	4	2
9.	BM5513	Summer Internship / Summer Project (Minimum 4 Weeks)	EEC	0	0	0	0	2
			TOTAL PERIODS	17	0	10	27	21

*Audit Course is optional

SEMESTER VI

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	BM5601	Diagnostic and Therapeutic Equipment II	PCC	3	0	0	3	3
2.	BM5602	Radiological Equipment	PCC	3	0	0	3	3
3.	EC5551	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Open Elective - I	OEC	3	0	0	3	3
PRACTICALS								
7.	BM5611	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	4	4	2
8.	EC5561	Microprocessor and Microcontroller Interfacing Laboratory	PCC	0	0	4	4	2
			TOTAL PERIODS	18	0	8	26	22

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SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.	BM5701	Bio Mechanics	PCC	3	0	0	3	3
2.	BM5702	Principles of Digital Image Processing	PCC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	0	3	3
4.		Professional Elective V	PEC	3	0	0	3	3
5.		Open Elective II	OEC	3	0	0	3	3
PRACTICALS								
6.	BM5711	Hospital Training	EEC	0	0	0	0	2
7.	BM5712	Medical Image Processing Laboratory	PCC	0	0	4	4	2
8.	BM5713	Project I	EEC	0	0	6	4	3
			TOTAL PERIODS	15	0	10	23	22

SEMESTER VIII

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
THEORY								
1.		Professional Elective VI	PEC	3	0	0	3	3
2.		Professional Elective VII	PEC	3	0	0	3	3
PRACTICALS								
3.	BM5811	Project II	EEC	0	0	16	16	8
			TOTAL PERIODS	6	0	16	22	14

TOTAL CREDITS: 168

PROJECT PHASE I & II:

Review Committee may include Experts from industry and clinical sides so that the students can be encouraged to take up industry and society relevant projects.

PROGRESS THROUGH KNOWLEDGE

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HSMC COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	HS5251	Professional Communication	HSMC	4	0	0	4	4
3.	HM5404	Hospital Management	HSMC	3	0	0	3	3

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Processes	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5271	Gender, Culture and Development	3	0	0	3
2.	HU5272	Ethics and Holistic Life	3	0	0	3
3.	HU5273	Law and Engineering	3	0	0	3
4.	HU5274	Film Appreciation	3	0	0	3
5.	HU5275	Fundamentals of Language and Linguistics	3	0	0	3
6.	HU5276	Understanding Society and Culture through Literature	3	0	0	3

BASIC SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
2.	PH5151	Engineering Physics	BSC	3	0	0	3	3
3.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
4.	BS5161	Basic Sciences	BSC	0	0	4	4	2

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
		Laboratory						
5.	MA5252	Engineering Mathematics II	BSC	0	0	4	4	2
6.	MA5355	Transform Techniques and Partial Differential Equations	BSC	3	1	0	4	4
7.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
8.	BM5201	Anatomy and Physiology	BSC	3	0	0	3	3

ENGINEERING SCIENCE COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
2.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
3.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
4.	EC5251	Circuit Theory	ESC	3	0	0	3	3
5.	BM5302	Java Programming	ESC	2	0	2	4	3
6.	EE5261	Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
7.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
8.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2

PROFESSIONAL CORE COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	BM5301	Sensors and Measurements	PCC	3	0	0	3	3
2.	EC5305	Electron Devices and Circuits	PCC	3	0	0	3	3
3.	BM5401	Fundamentals of Biochemistry	PCC	3	0	0	3	3
4.	EC5406	Analog and Digital Integrated Circuits	PCC	3	0	0	3	3
5.	BM5402	Control System for Biomedical Engineering	PCC	3	0	0	3	3
6.	BM5403	Biomedical Instrumentation	PCC	3	0	0	3	3

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
7.	BM5502	Discrete Time Signal Processing	PCC	3	0	0	3	3
8.	BM5503	Pathology and Microbiology	PCC	2	0	2	4	3
9.	BM5601	Diagnostic and Therapeutic Equipment II	PCC	3	0	0	3	3
10.	BM5602	Radiological Equipment	PCC	3	0	0	3	3
11.	EC5551	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
12.	EC5312	Devices and Circuits Laboratory	PCC	0	0	4	0	2
13.	BM5311	Sensors and Measurements Laboratory	PCC	0	0	4	0	2
14.	BM5411	Biochemistry and Human Physiology Laboratory	PCC	0	0	4	0	2
15.	EC5413	Analog and Digital Integrated Circuits Laboratory	PCC	0	0	4	0	2
16.	BM5501	Diagnostic and Therapeutic Equipment I	PCC	3	0	0	3	3
17.	BM5502	Discrete Time Signal Processing	PCC	3	0	0	3	3
18.	BM5701	Bio Mechanics	PCC	3	0	0	3	3
19.	BM5702	Principles of Digital Image Processing	PCC	3	0	0	3	3
20.	BM5511	Digital Signal Processing Laboratory	PCC	0	0	4	0	2
21.	BM5512	Biomedical Instrumentation Laboratory	PCC	0	0	4	0	2
22.	BM5611	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	4	0	2
23.	EC5561	Microcontroller and Interfacing Laboratory	PCC	0	0	4	0	2
24.	BM5712	Medical Image Processing Laboratory	PCC	0	0	4	0	2

EEC COURSES

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	BM5513	Summer Internship / Summer Project (Minimum 4 Weeks)	EEC	0	0	0	0	2

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Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
2.	BM5711	Hospital Training	EEC	0	0	0	0	2
3.	BM5713	Project I	EEC	0	0	6	6	3
4.	BM5811	Project II	EEC	0	0	16	16	8

PROFESSIONAL ELECTIVES COURSES

SI. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CONTACT PERIODS	C
1.	BM5001	Pattern Recognition and Neural Networks	PEC	3	0	0	3	3
2.	BM5002	Medical Informatics	PEC	3	0	0	3	3
3.	BM5003	Medical Ethics and Standards	PEC	3	0	0	3	3
4.	BM5004	Communication Engineering	PEC	3	0	0	3	3
5.	BM5005	Bio Signal Processing	PEC	3	0	0	3	3
6.	BM5006	Biomaterials and Artificial Organs	PEC	3	0	0	3	3
7.	BM5007	Biomaterials and Characterisation	PEC	3	0	0	3	3
8.	BM5008	Biometric Systems	PEC	3	0	0	3	3
9.	BM5009	Body Area Networks	PEC	3	0	0	3	3
10.	BM5010	Brain Computer Interface and Applications	PEC	3	0	0	3	3
11.	BM5011	Physiological Modelling	PEC	3	0	0	3	3
12.	BM5012	Medical Optics	PEC	3	0	0	3	3
13.	BM5013	Medical Physics	PEC	3	0	0	3	3
14.	BM5014	MEMS and its Biomedical Applications	PEC	3	0	0	3	3
15.	BM5015	Rehabilitation Engineering	PEC	3	0	0	3	3
16.	BM5016	Virtual Reality in Medicine	PEC	3	0	0	3	3
17.	BM5017	Wearable Systems	PEC	3	0	0	3	3
18.	BM5018	Neural Engineering	PEC	3	0	0	3	3
19.	BM5019	Advanced Bio Analytical and Therapeutic Techniques	PEC	3	0	0	3	3
20.	BM5020	Principles of Tissue Engineering	PEC	3	0	0	3	3
21.	BM5021	Computer Hardware and Interfacing	PEC	3	0	0	3	3
22.	EC5071	Advanced Microcontrollers	PEC	3	0	0	3	3
23.	EC5072	Cryptography and Network Security	PEC	3	0	0	3	3
24.	EC5073	Electro Magnetic Interference and Compatibility	PEC	3	0	0	3	3
25.	EC5074	Foundations for Nano Electronics	PEC	3	0	0	3	3

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SI. No	Course Code	Course Title		Lecture	Tutorial	Practical	Total Contact Periods	Credits
26.	EC5076	Multimedia Compression and Networks	PEC	3	0	0	3	3
27.	EC5077	Real Time Embedded Systems	PEC	3	0	0	3	3
28.	EC5078	Robotics	PEC	3	0	0	3	3
29.	EC5079	Soft Computing and Applications	PEC	3	0	0	3	3
30.	EC5080	Speech Processing	PEC	3	0	0	3	3
31.	EC5028	Computer Architecture and Organization	PEC	3	0	0	3	3
32.	EC5029	VLSI Design	PEC	3	0	0	3	3
33.	GE5073	Foundation Skills in Integrated Product Development	PEC	3	0	0	3	3
34.	BM5022	Virtual Instrumentation	PEC	2	0	2	4	3
35.	BM5023	Bio Statistics	PEC	3	0	0	3	3
36.	BM5024	Internet of Things in Medicine	PEC	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SI. No	Course Code	CourseTitle	Periodsperweek			Total Contact Periods	Credits
			Lecture	Tutorial	Practical		
1.	AD5091	Constitution of India	3	0	0	3	0
2.	AD5092	Value Education	3	0	0	3	0
3.	AD5093	Pedagogy Studies	3	0	0	3	0
4.	AD5094	Stress Management by Yoga	3	0	0	3	0
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	3	0
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	3	0
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	3	0
8.	AD5098	Sanga Tamil Literature Appreciation	3	0	0	3	0
				Total Credits:		24	0

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SUMMARY

SI. No.	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	4	3	3	3				17
2	BSC	12	4	4	3					23
3	ESC	5	15	3						22
4	PCC		3	10	16	13	13	8		63
5	PEC					3	6	6	6	21
6	OEC						3	3		6
7	EEC					2		5	8	15
	Total	**21**	**25**	**20**	**22**	**21**	**22**	**22**	**14**	**168**
8	Non-Credit /(Audit Course)				*	*				
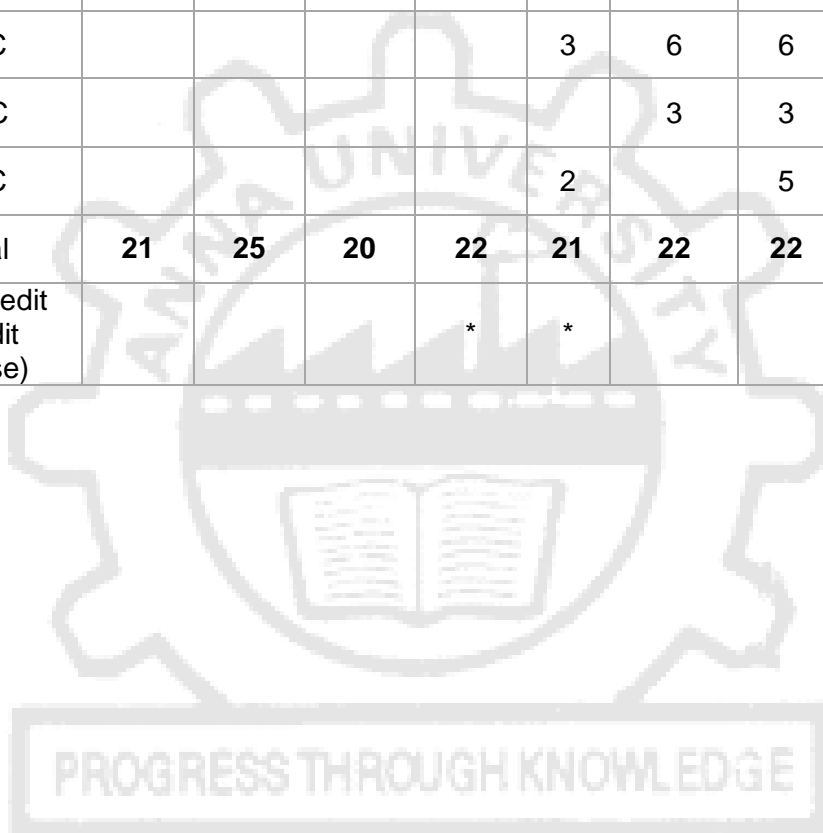
TECHNICAL ENGLISH L T P C
4 0 0 4

OBJECTIVES:
The first semester English course entitled 'Technical English' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I   INTRODUCING ONESELF   12
Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself – introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II   DIALOGUE WRITING   12
Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)-**Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III   FORMAL LETTER WRITING   12
Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic- **Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)-**Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV   WRITING COMPLAINT LETTERS   12
Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V   WRITING DEFINITIONS AND PRODUCT DESCRIPTION   12
Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL: 60 PERIODS

COURSE OUTCOMES
At the end of the course the students will have gained,
CO1: Exposure to basic aspects of technical English.
CO2: The confidence to communicate effectively in various academic situations.
CO3: Learnt the use of basic features of Technical English.

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TEXTBOOK:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATICS – I	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes in I Semester)	3	1	0	4

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I   MATRICES   12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II   DIFFERENTIAL CALCULUS   12

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III   FUNCTIONS OF SEVERAL VARIABLES   12

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV   INTEGRAL CALCULUS   12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V   MULTIPLE INTEGRALS   12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL : 60 PERIODS

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COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Use the matrix algebra methods for solving practical problems.
CO2: Apply differential calculus tools in solving various application problems.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:
1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 6th Edition, 2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, New Delhi, 14th Edition, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:
1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, New Delhi, 10th Edition, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, 2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, New Delhi, 5th Edition, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi , 7th Edition, 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.

PH5151	ENGINEERING PHYSICS	L T P C
	(Common to all branches of B.E / B.Tech programmes)	3 0 0 3

OBJECTIVE
- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I   MECHANICS   9
Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II   ELECTROMAGNETIC WAVES   9
Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III   OSCILLATIONS, OPTICS AND LASERS   9
Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV   BASIC QUANTUM MECHANICS   9
Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V   APPLIED QUANTUM MECHANICS   9
The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOME
After completion of this course, the students will be able to
CO1: Understand the importance of mechanics.
CO2: Express the knowledge of electromagnetic waves.
CO3: Know the basics of oscillations, optics and lasers.
CO4: Understand the importance of quantum physics.
CO5: Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS:
1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker, "Principles of Physics", John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students", Springer-Verlag, 2012.

REFERENCES:
1. R.Wolfson, "Essential University Physics", Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths, "Introduction to Electrodynamics", Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak, "Lasers: Fundamentals and Applications", Springer, 2012.

CY5151   **ENGINEERING CHEMISTRY**   **L T P C**
                              (COMMON TO ALL BRANCHES)   **3 0 0 3**

OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photoprocesses and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I   POLYMER CHEMISTRY   9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II   NANOCHEMISTRY   9

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III   PHOTOCHEMISTRY AND SPECTROSCOPY   9

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV   ENERGY CONVERSIONS AND STORAGE   9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V   WATER TECHNOLOGY   9

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.

CO2: To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3: To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.

CO4: To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

CO5: To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16th Edition, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCE BOOKS:

1. Schdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V RGowariker, N V Viswanathan and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 2009.

GE5153	PROBLEM SOLVING AND PYTHON PROGRAMMING	L T P C
		3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I   INTRODUCTION TO COMPUTING AND PROBLEM SOLVING   9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

SUGGESTED ACTIVITIES:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

SUGGESTED EVALUATION METHODS:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II   CONDITIONALS AND FUNCTIONS   9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

SUGGESTED ACTIVITIES:
- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

SUGGESTED EVALUATION METHODS:
- Tutorials on the above activities.
- Group discussion on external learning.

UNIT III   SIMPLE DATA STRUCTURES IN PYTHON   10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

SUGGESTED ACTIVITIES:
- Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

SUGGESTED EVALUATION METHODS:
- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV   STRINGS, DICTIONARIES, MODULES   10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

SUGGESTED ACTIVITIES:
- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

SUGGESTED EVALUATION METHODS:
- Tutorials on the above activities.

UNIT V   FILE HANDLING AND EXCEPTION HANDLING   7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

SUGGESTED ACTIVITIES:
- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks - for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

SUGGESTED EVALUATION METHODS:
- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:
1. Reema Thareja, "Python Programming: Using Problem Solving Approach", Oxford University Press, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Shroff/O'Reilly Publishers, 2nd Edition, 2016.
   (http://greenteapress.com/wp/thinkpython/).

REFERENCES:
1. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 3.2", Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

GE5161   PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY   L T P C
0 0 4 2

OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.
9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python data structures.
CO6: Apply Python features in developing software applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

BS5161	**BASIC SCIENCES LABORATORY** (Common to all branches of B.E. / B.Tech Programmes)	**L T P C** **0 0 4 2**

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE
- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids

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11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

COURSE OUTCOME
Upon completion of the course, the students will be able
CO1: To determine various moduli of elasticity and also various thermal and optical properties of materials.
CO2: To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:
1. Estimation of HCl using Na2CO3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler"s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
CO3: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO4: To determine the amount of metal ions through volumetric and spectroscopic techniques
CO5: To determine the molecular weight of polymers by viscometric method.
CO6: To quantitatively analyse the impurities in solution by electroanalytical techniques
CO7: To design and analyse the kinetics of reactions and corrosion of metals

TEXT BOOKS:
1. Laboratory Manual- Department of Chemistry, CEGC, Anna University, 2014.
2. Vogel"s Textbook of Quantitative Chemical Analysis, 8th Edition, 2014.

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PROFESSIONAL COMMUNICATION L T P C
4 0 0 4

COURSE OBJECTIVES
The course entitles ' Professional Communication' aims to,
- Improve the relevant language skills necessary for professional communication.
- Develop linguistic and strategic competence in workplace context.
- Enhance language proficiency and thereby the employability of budding engineers and technologists.

UNIT I   TECHNICAL COMMUNICATION   12
Listening: Listening to telephone conversations (intent of the speaker and note taking exercises)- Speaking: Role play exercises based on workplace contexts, introducing oneself- Reading: Reading the interview of an achiever and completing exercises (skimming, scanning and predicting)- Writing: Writing a short biography of an achiever based on given hints- Grammar: Asking and answering questions, punctuation in writing, prepositional phrases- Vocabulary Development: use of adjectives.

UNIT II   SUMMARY WRITING   12
Listening: Listening to talks/lectures both general and technical and summarizing the main points- Speaking: Participating in debates- Reading: Reading technical essays/ articles and answering comprehension questions-Writing: Summary writing-Grammar: Participle forms, relative clauses- Vocabulary Development: Use of compound words, abbreviations and acronyms.

UNIT III   PROCESS DESCRIPTION   12
Listening: Listening to a process description and drawing a flowchart-Speaking: Participating in Group Discussions, giving instructions- Reading: Reading instruction manuals- Writing: Writing process descriptions- Writing instructions- Grammar: Use of imperatives, active and passive voice, sequence words- Vocabulary Development: Technical jargon

UNIT IV   REPORT WRITING   12
Listening: Listening to a presentation and completing gap-filling exercises- Speaking: Making formal presentations- Reading: Reading and interpreting charts/tables and diagrams- Writing: Interpreting charts/tables and diagrams, writing a report- Grammar: Direct into indirect speech, use of phrases- Vocabulary Development: reporting words

UNIT V   WRITING JOB APPLICATIONS   12
Listening: Listening to a job interview and completing gap=filling exercises- Speaking: Mock interview, telephone interviews- Reading: Reading a job interview, SOP, company profile and completing comprehension exercises- Writing: job applications and resumes and SOPs-Grammar: Present perfect and continuous tenses- Vocabulary Development: Technical vocabulary.

TOTAL: 60 PERIODS

COURSE OUTCOMES
At the end of the second semester the learners will be able to,
CO1: Read and comprehend technical texts effortlessly.
CO2: Write reports of a technical kind.
CO3: Speak with confidence in interviews and thereby gain employability.

TEXTBOOK
1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited, 2019.

Assessment Pattern
- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

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MA5252	**ENGINEERING MATHEMATICS – II**	**L**	**T**	**P**	**C**
	(Common to all branches of B.E. / B.Tech. Programmes in II Semester)	**3**	**1**	**0**	**4**

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I   VECTOR CALCULUS   12

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II   ANALYTIC FUNCTION   12

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z, \ az, \ 1/z, \ z^2$.

UNIT III   COMPLEX INTEGRATION   12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT IV   DIFFERENTIAL EQUATIONS   12

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT V   LAPLACE TRANSFORMS   12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1: Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.

CO2: Construct analytic functions and use their conformal mapping property in application problems.

CO3: Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.

CO4: Apply various methods of solving differential equation which arise in many application problems.

CO5: Apply Laplace transform methods for solving linear differential equations.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:
1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

GE5152	ENGINEERING MECHANICS	L T P C
		3 1 0 4

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
- Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
- Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
- Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
- Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I   STATICS OF PARTICLES   9+3
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNITII   EQUILIBRIUM OF RIGID BODIES   9+3
Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNIT III   DISTRIBUTED FORCES   9+3
Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus - Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.
Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass -   Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV   FRICTION   9+3

The Laws of Dry Friction.Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNIT V   DYNAMICS OF PARTICLES   9+3

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

TOTAL (L: 45 + T: 15)=60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

CO1: Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.

CO2: Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.

CO3: Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.

CO4: Apply the concepts of frictional forces at the contact surfaces of various engineering systems.

CO5: Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:
1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:
1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, Cengage learning, 1st Edition, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, Prentice Hall, 13th Edition, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 4th Edition, 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, Wiley student edition, 7th Edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, McGraw Hill Higher Education, 5th Edition, 2013.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
2	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
3	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
4	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
5	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6

EE5251   **BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING**   **L T P C**
                                                                            3 0 0 3

OBJECTIVES:
- To understand the basic concepts of electric circuits, magnetic circuits and wiring.
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices and circuits.

UNIT I   BASIC CIRCUITS AND DOMESTIC WIRING   9
Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II   THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS   9
Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads-Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

UNIT III   ELECTRICAL MACHINES   9
Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

UNIT IV   BASICS OF ELECTRONICS   9
Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V   CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES   9
Working principle and characteristics - BJT, SCR, JFET, MOSFET.

                                                                    TOTAL: 45 PERIODS

OUTCOMES:

CO1   To be able to understand the concepts related with electrical circuits and wiring.
CO2   To be able to study the different three phase connections and the concepts of magnetic
         circuits.
CO3   Capable of understanding the operating principle of AC and DC machines.
CO4   To be able to understand the working principle of electronic devices such as diode and
         zener diode.
CO 5   To be able to understand the characteristics and working of current controlled and
         voltage controlled devices.

TEXT BOOKS:
1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
2. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, 2nd Edition, New Delhi, 1989.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5th Edition, 2013.

REFERENCES:
1. Thomas L. Floyd, 'Electronic Devices', Pearson Education, 10th Edition, 2018.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education, 7th Edition, 2017.
3. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill, 2010.
4. Muhammad H.Rashid, "Spice for Circuits and electronics", Cengage India, 4th Edition, 2019.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓						✓	
CO3	✓	✓	✓	✓	✓						✓	✓
CO4	✓	✓	✓	✓	✓						✓	✓
CO5	✓		✓	✓	✓						✓	✓

EC5251   **CIRCUIT THEORY**   **L T P C**
                                                                       3 1 0 4

OBJECTIVES:
To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology.

UNIT I   DC CIRCUIT ANALYSIS   9+3
Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law, The single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.

UNIT II   NETWORK THEOREM AND DUALITY   9+3
Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits.

UNIT III   SINUSOIDAL STEADY STATE ANALYSIS   9+3
Sinusoidal Steady – State analysis , Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT IV   TRANSIENTS AND RESONANCE IN RLC CIRCUITS   9+3
Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit-Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT V   COUPLED CIRCUITS AND TOPOLOGY   9+3
Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer, An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis.

                                                          TOTAL: 60 PERIODS

COURSE OUTCOMES:
CO1: Ability to comprehend and design ac/dc circuits.

CO2 : Develop and understand ac/dc circuits.

CO3 : To be capable of evaluating ac/dc circuits.

CO4 : Ability to analyze electrical circuits.

CO5 : To inherit the ability to apply circuit theorems in real time.

TEXT BOOKS:
1. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, 9th Edition, 2018.
2. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014.

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REFERENCES:
1. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", Mc Graw- Hill, 2nd Edition, 2003.
2. D.R.Cunningham, J.A. Stuller, "Basic Circuit Analysis", Jaico Publishing House, 2005.
3. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7th Edition, 2009.
4. Charles.K.Alexander, Mathew N.O.Sadiku,"Fundamentals of Electric Circuits", McGraw Hill, 5th Edition, 2012.
5. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The Mc Graw Hill companies, 2nd Edition, 2011.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1		1					1	1
CO2	3	3	2	3		1					1	1
CO3	3	3	2	3		1					1	1
CO4	3	3	3	2		1					2	2
CO5	3	3	3	2		1					2	2

BM5201 **ANATOMY AND PHYSIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:
The student should be made to:
- Know basic structural and functional elements of human body.
- Learn organs and structures involving in system formation and functions.
- Understand all systems in the human body.

UNIT I   BASIC ELEMENTS OF HUMAN BODY   8
Cell: Structure and organelles - Functions of each component in the cell. Cell membrane – transport across membrane – Origin of cell membrane potential – Action potential. Homeostasis - Tissue: Types – Specialized tissues – functions.

UNIT II   RESPIRATORY SYSTEM AND URINARY SYSTEM   9
Respiratory System: Components of respiratory system – Respiratory Mechanism. Types of respiration - Oxygen and carbon dioxide transport and acid base regulation. Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation – Urinary reflex – Homeostasis and blood pressure regulation by urinary system.

UNIT III   BLOOD AND CARDIOVASCULAR SYSTEM   10
Blood composition - functions of blood – functions of RBC.WBC types and their functions Blood groups – importance of blood groups – identification of blood groups. Blood vessels - Structure of heart – Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – Heart sound - Volume and pressure changes and regulation of heart rate –Coronary Circulation. Factors regulating Blood flow.

Attested

UNIT IV   SKELETAL AND SPECIAL SENSORY SYSTEM   9
Skeletal system: Bone types and functions – Axial Skeleton and Appendicular Skeleton. Joint - Types of Joint – Cartilage structure, types and functions. Special Sensory system- Eye, Ear and Skin - diseases and related surgery.

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UNIT V   NERVOUS SYSTEM   9

Structure of a Neuron – Types of Neuron. Neuroglial Cells - Synapses and types. Brain – Divisions of brain lobes – Cross Sectional Anatomy of Brain - Cortical localizations and functions. Spinal cord – Tracts of spinal cord – Spinal Nerve - Reflex mechanism – Types of reflex. Autonomic nervous system and its functions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The student will have knowledge to:
CO1: Describe basic structural and functional elements of human body.
CO2: Explain gaseous exchange and fluid maintenance in the human body.
CO3: Enlighten organs and structures involving in system formation and functions.
CO4: Identify all systems in the human body.
CO5: Elucidate special senses in the human body.

TEXT BOOKS:
1. Elaine.N. Marieb, "Essential of Human Anatomy and Physiology", Pearson Education New Delhi, 8th Edition, 2007.
2. Gillian Pocock, Christopher D. Richards, "The Human Body An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 2009.

REFERENCES:
1. William F. Ganong,"Review of Medical Physiology", Mc Graw Hill, New Delhi, 25th Edition, 2015.
2. Eldra Pearl Solomon. "Introduction to Human Anatomy and Physiology", W.B.Saunders Company, 2003.
3. Arthur C. Guyton, "Text book of Medical Physiology", Elsevier Saunders, 11th Edition, 2006

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√				√		√		√
CO2	√	√	√	√				√		√		√
CO3	√	√	√	√				√		√		√
CO4	√	√	√	√				√		√		√
CO5	√		√	√				√		√		√

GE5162	WORKSHOP PRACTICES LABORATORY	L T P C
	(Common to all Branches of B.E. / B.Tech. Programmes)	0 0 4 2

COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

PART I   CIVIL ENGINEERING PRACTICES   15

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART II   ELECTRICAL ENGINEERING PRACTICES   15

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III   MECHANICAL ENGINEERING PRACTICES   15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:
a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:
a) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) : 60 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2: Wire various electrical joints in common household electrical wire work.
CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1.	0.6	0.3											0.3	0.3	
2.		0.6	0.6											0.6	
3.		0.6	0.3										0.6	0.6	
4.		0.6	0.6	0.3										0.6	

PROGRESS THROUGH KNOWLEDGE

EE5261   ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY   L   T   P   C
0   0   4   2
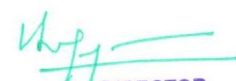
OBJECTIVES
1. To impart hands on experience in verification of circuit laws and measurement of circuit parameters
2. To train the students in performing various tests on electrical motors.
3. It also gives practical exposure to the usage of CRO, power sources & function generators

LIST OF EXPERIMENTS
1. Verification of Kirchhoff's Law.
2. Steady state response of AC and DC circuits (Mesh, Node Analysis)
3. Frequency response of RLC circuits.
4. Measurement power in three phase circuits by two-watt meter method.
5. Regulation of single phase transformer.
6. Performance characteristics of DC shunt generator.

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7. Performance characteristics of single phase induction motor.
8. Characteristics of PN diode and Zener diode
9. Characteristics of Zener diode
10. Half wave and full wave Rectifiers
11. Application of Zener diode as shunt regulator.
12. Characteristics of BJT and JFET

TOTAL: 60 PERIODS

COURSE OUTCOMES:
CO1: To become familiar with the basic circuit components and know how to connect them to make a real electrical circuit.
CO2: Ability to perform speed characteristic of different electrical machines.
CO3: Ability to use logic gates and Flip flops.

MA5355	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS	L T P C
		3 1 0 4

OBJECTIVES:
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering :
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I   PARTIAL DIFFERENTIAL EQUATIONS   12
Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange's Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II   FOURIER SERIES   12
Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION   12
Classification of partial differential equations- Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in cartesian coordinates.

UNIT IV   FOURIER TRANSFORM   12
Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V   Z – TRANSFORM AND DIFFERENCE EQUATIONS   12
Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

Attested

TOTAL : 60 PERIODS

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COURSE OUTCOMES:
At the end of the course, students will be able to
CO1: Solve partial differential equations which arise in application problems.
CO2: Analyze the functions as an infinite series involving sine and cosine functions.
CO3: Obtain the solutions of the partial differential equations using Fourier series.
CO4: Obtain Fourier transforms for the functions which are needed for solving application problems.
CO5: Manipulate discrete data sequences using Z transform techniques.

TEXTBOOKS:
1. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.

REFERENCES:
1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 4th Edition, 2011.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 7th Edition, 2012.
4. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 11th Reprint, 2010.

BM5301 **SENSORS AND MEASUREMENTS** **L T P C**
3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the purpose of measurement, the methods of measurements, errors associated with measurements.
- To know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.
- To know the different display and recording devices.

UNIT I   **SCIENCE OF MEASUREMENT**   **7**
Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

UNIT II   **DISPLACEMENT, PRESSURE,TEMPERATURE SENSORS**   **11**
Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement & pressure transducers, RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple –characteristics.

UNIT III   **PHOTOELECTRIC AND PIEZOELECTRIC SENSORS**   **9**
Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

UNIT IV   **SIGNAL CONDITIONING & SIGNAL ANALYSER**   **9**
AC and DC Bridges – Wheat stone bridge, Kelvin, Maxwell, Hay, Schering – Concepts of filters, Pre-amplifier – impedance matching circuits – isolation amplifier. Spectrum analyzer.

UNIT V   DISPLAY AND RECORDING DEVICES   9

Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Demonstration of the display and recording devices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the student will be able to:

CO1: Describe the purpose and methods of measurements.
CO2: Explain the principle of different sensors and its applications.
CO3: Analyze the characteristics of different transducers.
CO4: Describe the need and function of various signal conditioning circuits.
CO5: Explain different display and recording devices for various applications.

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., "Measurement Systems", Tata McGraw-Hill Education Pvt. Ltd., 6th Edition, 2011.
2. L.A Geddes and L.E.Baker , "Principles of Applied Biomedical Instrumentation", – John Wiley and sons, 3rd Edition, Reprint 2008.
3. Albert D.Helfrick and William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.

REFERENCES:

1. A.K.Sawhney, "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai&Co, New Delhi, 17th Edition, 2004.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd, New Delhi, 2nd Edition, Reprint, 2013.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√					√						√
CO2	√	√	√	√			√	√		√		√
CO3	√	√	√	√			√	√		√		√
CO4	√	√	√	√	√	√						√
CO5	√	√	√	√			√			√		√

BM5302   **JAVA PROGRAMMING**   **L T P C**
                                                                     2 0 2 3

OBJECTIVES:

- To comprehend the Fundamentals of OOP and Java Language Constructs.
- To familiarize the student with Object Oriented Programming in Java.
- To solve problems using the OOP language constructs.
- To familiarize the functions and protocols of each layer of TCP/IP protocol suite.
- To Develop Web applications with Java.

UNIT I FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING AND JAVA 9

Introduction to OOP. Introduction to Java – Java Specifications, Java Language basics – Variables, Operators, Expressions, Statements, Blocks, Control flow Statements, Arrays, Classes and Objects, Strings, Constructors and Destructors, Type Casting, Package Access - Java API Packages.

UNIT II INHERITANCE, POLYMORPHISM AND EXCEPTION HANDLING IN JAVA 9

Inheritance - Sub Classes and Subclass Types, Exception Handling- Java Exception Hierarchy - User Defined Exception Types – Assertions - Garbage Collection and Method finalize, Polymorphism - Abstract Classes and Methods- Overloading and Overriding, Operator instance of and Down Casting - final Methods and Classes –Clone class - Interface – Implementation – Multithreading.

UNIT III FILES AND STREAMS IN JAVA 9

Files and Streams – Formatted Output - Object Concurrency- Serialization - Generic Collections - Generic Classes and Methods - Java utility Packages and Bit Manipulation – Java Collections.

UNIT IV INTRODUCTION TO THE INTERNET 9

Review of Network technologies, Internet addressing, Internet Protocols - TCP/IP, UDP, DNS and Domain Names, Higher-level Protocols, Address resolution protocols (ARP/RARP). E-Mail, Telnet, FTP, NFS.WWW- Versions - HTTP - Request and Response Messages - URI, URN, URL, MIME Type.

UNIT V JAVA PROGRAMMING IN THE INTERNET 9

Web Clients: - Introduction to HTML- CSS, XHTML, XML Parser – Client Side Scripting - Java Script, PHP. Connecting to web- Introduction to Java Applets- swings- Remote Method Invocation – Java Database Connectivity – connectivity - Querying statements – Results – JSP- Java servlets- Architecture- JSP Technology Introduction- Running basic JSP applications.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Design problem solutions using Object Oriented Techniques.
CO2: Apply the concepts of polymorphism, overloading, and inheritance for problem solutions.
CO3: Use the concepts of Java for problem solving.
CO4: Examine important technologies that are being used today by web developers to build a wide variety of web applications.
CO5: To design web applications using Java, Servlets, XML.

TEXT BOOKS:
1. Paul Dietel and Harvey Deitel, "Java How to Program" Pearson Education, 10th Edition, 2016.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann Publishers Inc., 5th Edition, 2011.
3. Robert W. Sebesta, "Programming the World Wide Web", Addison Wesley, 8th Edition, 2015.

REFERENCES:
1. Y. Daniel Liang, "Introduction to Java Programming Comprehensive Version", Pearson Education, 10th Edition, 2014.
2. Sachin Malhotra, Sourabh Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2018.
3. William Stallings, "Data and Computer Communications", Pearson Education, 10th Edition, 2013.
4. Deitel and Deitel, "Internet and World Wide Web: How to Program", Pearson Education, 5th Edition, 2012.
5. http://www.w3schools.com

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COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√							
CO2	√	√	√	√	√							
CO3	√	√	√	√	√							
CO4					√				√	√	√	√
CO5					√				√	√	√	√

EC5305   **ELECTRONIC DEVICES AND CIRCUITS**   **L T P C**
                                                                                    3 0 0 3

OBJECTIVES:
The student should be made to:
- Be familiar with the structure of basic electronic devices.
- Be exposed to the operation and applications of electronic devices.

UNIT I   PN JUNCTION DEVICES   9
PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Rectifiers – Half Wave and Full Wave Rectifier, Zener diode-characteristics-Zener Reverse characteristics – Zener as regulator, Display devices- LED- characteristics, Laser diodes.

UNIT II   TRANSISTORS   9
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing. UJT, Thyristor (DIAC, SCR, TRIAC) and IGBT -Structure and characteristics.

UNIT III   AMPLIFIERS   9
BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response. MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV   MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER   9
BIMOS cascode amplifier, Differential amplifier – Common mode and Differential mode analysis – FET input stages. Single tuned amplifiers – Gain and frequency response – Neutralization methods. Power amplifiers –Class A, Class B, Class AB, Class C (Qualitative analysis).

UNIT V   FEEDBACK AMPLIFIERS, OSCILLATORS AND REGULATORS   9
Basic concepts of feedback -Properties of negative feedback – voltage / current, series, Shunt feedback – Positive feedback – Condition for oscillations - phase shift – Wien bridge, Hartley, Colpitts, Clapp and Crystal oscillators. Basic concept of regulators, SMPS.

                                                                                    TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon Completion of the course, the students will be able to:
CO1: Explain the structure of basic electronic devices.
CO2: Design amplifier circuits and apply negative feedback principle to amplifier stages.
CO3: Realize power amplifier circuits for a given specification.
CO4: Apply positive feedback principle and design oscillators.
CO5: Understand the specifications of regulators and power supply circuits.

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TEXT BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2008.
2. Sedra and Smith, "Microelectronic circuits", Oxford University Press, 7th Edition, 2014.

REFERENCES:

1. Muhammad H. Rashid, "Microelectronic Circuits: Analysis and Design", Cengage Learning, 6th Edition, 2013.
2. Thomas L. Floyd, "Electronic devices" Prentice Hall", 10th Edition, 2018.
3. Donald A Neamen, "Electronic Circuit Analysis and Design", Tata Mc Graw Hill, 4th Edition, 2009.
4. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 11th Edition, 2015.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√								√
CO2	√	√	√									√
CO3		√	√	√	√					√		√
CO4		√	√	√	√					√		√
CO5	√	√								√		√

EC5312   **DEVICES AND CIRCUITS LABORATORY**   **L T P C**
                                                             0 0 4 2

OBJECTIVES:
The student should be made to:
- Be exposed to RL and RC circuits
- Be familiar with Thevenin & Norton theorem KVL & KCL, and Super Position Theorems
- Know series and parallel resonance circuits.
- Learn the characteristics of basic electronic devices.
- Understand the characteristics of Amplifiers.

LIST OF EXPERIMENTS
1. Verification of ohm's law, Kirchhoff's law, and Thevenin's theorem
2. Verification of superposition theorem and Maximum power transfer theorem
3. Frequency response of series resonance and parallel resonance circuits
4. Transient analysis of RL and RC circuits.
5. PN Junction Diode Characteristics and application as half wave and full wave rectifiers
6. Zener Diode Characteristics and application as voltage regulator
7. FET Characteristics
8. Characteristics of Thyristor and UJT
9. Frequency Response of CE Amplifier
10. Design and Analysis of Feedback Amplifiers
11. Design and Analysis of Differential Amplifier
12. Design of RC Oscillators and LC Oscillators using BJT.
13. General PCB design and practice for simple circuits
14. Design and analysis of simple circuits using simulation tools.

TOTAL: 60 PERIODS

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OUTCOMES:
At the end of the course, the student should be able to:
- Design RL and RC circuits
- Verify Thevenin & Norton theorem KVL & KCL, and Super Position Theorems
- Draw the characteristics of series and parallel resonance circuits.
- Discuss the characteristics of basic electronic devices.
- Describe the characteristics of Amplifiers

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√				√			√
CO2	√	√	√	√	√				√			√
CO3	√	√	√	√	√				√			√
CO4	√	√	√	√	√				√			√
CO5	√	√	√	√	√				√			√

BM5311 **SENSORS ANDMEASUREMENTSLABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To study the characteristics of sensors, signal conditioning circuits and display devices.

LIST OF EXPERIMENTS:
1. Characteristics of strain gauges.
2. Displacement measurement using LVDT.
3. Characteristics of temperature sensor-thermistor
4. Characteristics of temperature sensor-RTD.
5. Characteristics of thermocouple
6. Characteristics of Light sensors-LDR, Photo Diode, Photo Transistor.
7. Characteristics of Piezoelectric Transducer.
8. Wheatstone Bridge and Kelvin's Bridge for Measurement of Resistance.
9. Measurement of capacitance using bridge circuits.
10. Measurement of inductance using bridge circuits.
11. Characteristics of passive filters.
12. Force measurement using force sensor and calibration.
13. Study of Multimeter and Medical Oscilloscope.
14. Study of Input / Output characteristics using X – Y oscilloscope.

TOTAL: 60 PERIODS

OUTCOMES:
CO1 : Design and understand characteristics and calibration of various transducers.
CO2: Design and develop bridge circuits to find unknown variables.
CO3: Design and analyze filter characteristics.
CO4: Understand various read out and display devices.
CO5: Students can design a measurement system for various applications.

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COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√					√		√	√
CO2	√	√	√	√					√		√	√
CO3	√	√	√	√					√		√	√
CO4	√	√	√	√					√		√	√
CO5	√	√	√	√					√		√	√

BM5401   **FUNDAMENTALS OF BIOCHEMISTRY**   **L T P C**
                                                                      3 0 0 3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To get a clear idea of biomolecules and their functions.
- To know the significance of biomolecules in biological systems.
- To understand the metabolic pathways in normal and pathological conditions.

UNIT I   INTRODUCTION TO BIOCHEMISTRY   9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson - Hassel Balch equation, physiological buffers, fitness of the aqueous environment for living organism . Principle of viscosity, surface tension, adsorption, diffusion, osmosis and their applications in biological systems.

UNIT II   CARBOHYDRATES   9

Classification of carbohydrates mono, di, oligo and polysaccharides. Isomerism, racemisation and mutarotation. Structure, physical and chemical properties of carbohydrates. Metabolic pathways and bioenergetics – Glycolysis, glycogenesis, glycogenolysis and its hormonal regulation. TCA cycle and electron transport chain. Oxidative phosphorylation.

UNIT III   LIPIDS   9

Classification of lipids- simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Saponification number, Reichert- Meissl number and iodine number. Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, structural architecture and significance of biological membrane.

UNIT IV   NUCLEIC ACID& PROTEIN   9

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, chargaffs rule. Watson and crick model of DNA. Structure of RNA and its type. Classification, structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Separation of protein: gel filtration, electrophoresis and ultracentrifugation.

UNIT V   ENZYME AND ITS KINETICS   9

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes - Michaelis - Menten equation. Factors affecting enzymatic activity: temperature, pH, substrate concentration and enzyme concentration. Inhibitors of enzyme action: Competitive, non-competitive, irreversible. Enzyme: Mode of action, allosteric and covalent regulation. Clinical significance of enzymes. Measurement of enzyme activity and interpretation of units.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the student is able to
CO1: Describe the surface properties involved in biological systems.
CO2: Explain about bio molecules such as Carbohydrates, Lipids, Nucleic Acid & Protein
CO3: Explain functions of bio molecules
CO4: Assess the significance of biomolecules in biological systems.
CO5: Analyze the etiology and biological parameters in metabolic diseases.

TEXT BOOKS:

1. David L.Nelson, Michael M.Cox, Lehninger "Principles of Biochemistry Macmillan", 6th Edition 2013.
2. Keith Wilson and John Walker, "Practical Biochemistry– Principles &Techniques", Oxford University press, 7th Edition, 2010.

REFERENCES:

1. Trevorpalmer, "Understanding Enzymes", Ellis Horwood LTD, 4th Edition, 1995.
2. Pamela. C. Champe and Richard. A. Harvey, "Biochemistry Lippincott's Illustrated Reviews. Lippincott" Raven publishers, 6th Edition, 2013.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√		√			√					√
CO2	√	√		√								√
CO3	√	√		√								√
CO4	√	√		√								√
CO5	√	√		√			√	√				√

EC5406   **ANALOG AND DIGITAL INTEGRATED CIRCUITS**   **L T P C**
                                                                         3 0 0 3

OBJECTIVES:
- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To introduce the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
- To introduce the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous sequential circuits

UNIT I   **INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS**   **9**
Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Noninverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.

UNIT II   **DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS AND PLL**   **9**
Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

UNIT III   THE BASIC GATES ANDCOMBINATIONAL LOGIC CIRCUITS   9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map and Tabulation methods. Logic families- TTL, MOS, CMOS, BiCMOS - Comparison of Logic families.

UNIT IV   COMBINATIONAL LOGIC CIRCUITS   9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Implementation of combinational logic using standard ICs, ROM, PLA and PAL.

UNIT V   SEQUENTIAL LOGIC CIRCUITS   9

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to design new analog linear circuits and develop linear IC based Systems.

CO2: Understand the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.

CO3: Use Boolean algebra and apply it to digital systems.

CO4: Design various combinational digital circuits using logic gates.

CO5: Bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

TEXT BOOKS:

1. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Mc Graw Hill Education, 3rd Edition, 2017.
2. M. Morris Mano and Michael D.Ciletti, "Digital Design", Pearson, 5th Edition, 2013.
3. Charles H.Roth, Jr, "Fundamentals of Logic Design", Jaico Books, 7th Edition, 2013.

REFERENCES:

1. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2009.
2. Michael Jacob J., "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 2nd Edition, 2008.
3. Ramakant A. Gayakwad, "OP - AMP and Linear IC's", Prentice Hall, 2012.
4. Taub and Schilling, "Digital Integrated Electronics", Mc Graw Hill, 2017.
5. Coughlin and Driscoll, "Operational amplifiers and Linear Integrated Circuits", Prentice Hall, 6th Edition, 2001.
6. Floyd T.L., "Digital Fundamentals", Charles E.Merril publishing company, 8th Edition, 2005.
7. John.F.Wakerly, "Digital design principles and practices", Pearson Education, 5th Edition, 2018.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√						√		√
CO2	√	√	√	√						√		√
CO3	√	√	√	√						√		√
CO4	√	√	√	√						√	Attested √	√
CO5	√	√	√	√	√					√		√

ENVIRONMENTAL SCIENCES

OBJECTIVES:
- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization-environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of

Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V   HUMAN POPULATION AND THE ENVIRONMENT   6
Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2: To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
CO3: To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
CO4: To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
CO5: To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:
1. Anubha Kaushik and C. P. Kaushik's, "Perspectives in Environmental Studies", New Age International Publishers, 6th Edition, 2018.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education, 2nd Edition, 2004.

REFERENCES:
1. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice Hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd., 2013.

BM5402	CONTROL SYSTEM FOR BIOMEDICALENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:
- To study the mathematical techniques for analysis of given system.
- To study the given system in time domain and frequency domain analysis.
- To study the stability analysis of the given system.
- To study the concept of physiological control system.

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UNIT I   CONTROL SYSTEM MODELING   9

Terminology and basic structure of control system, example of a closed loop system, transfer function, modeling of electrical systems, translational and rotational mechanical systems, and electromechanical systems, block diagram and signal flow graph representation of systems, reduction of block diagram and signal flow graph, conversion of block diagram to signal flow graph. Need for modeling physiological system.

UNIT II   TIMERESPONSE ANALYSIS   9

Step and impulse responses of first order and second order systems, determination of time domain specifications of first and second order systems from its output responses, definition of steady state error constants and its computations. Introduction to PI,PD and PID controllers.

UNIT III   STABILITY ANALYSIS   9

Definition of stability, Routh- Hurwitz criteria of stability, root locus technique, construction of root locus and study of stability, definition of dominant poles and relative stability.

UNIT IV   FREQUENCY RESPONSE ANALYSIS   9

Frequency response, Nyquist stability criterion, Nyquist plot and determination of closed loop stability, definition of gain margin and phase margin, Bode plot, determination of gain margin and phase margin using Bode plot, use of Nichol's chart to compute frequency and bandwidth.

UNIT V   PHYSIOLOGICAL CONTROL SYSTEM   9

Example of physiological control system, difference between engineering and physiological control systems, generalized system properties, models with combination of system elements, linear models of physiological systems-Examples, introduction to simulation. Illustration with real time applications.

                                                                TOTAL: 45 PERIODS.

COURSE OUTCOMES:

The students will be able to:

CO1: Develop mathematical model for a given system.
CO2: Determine and analyze the time domain specifications of different systems.
CO3: Perform stability analysis of the given system using various techniques.
CO4: Determine and Analyze the frequency domain specifications of the different systems.
CO5: Explain the concept and model of physiological control systems.

TEXT BOOKS:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 6th Edition, 2008.
2. Michael C K Khoo, "Physiological control systems", IEEE Press, Prentice Hall of India, 2005.

REFERENCES:

1. Farid Golnaraghi, Benjamin C. Kuo, "Automatic Control Systems", Wiley, 9th Edition, 2014.
2. M. Gopal, "Control System, Principles and Design", McGraw-Hill, 2012.
3. Constantine H.Houpis, Stuart N. Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Press, 6th Edition, 2013.
4. Richard C.Dorf & Robert H. Bishop, "Modern Control Systems", Prentice Hall, 12th Edition, 2010.
5. Joseph J.DiStefano, Allen R.Stubberud, Schaum's, "Outline of Feedback and Control Systems", McGraw-Hill Education, 2nd Edition, 2013.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√								√
CO2	√	√	√	√								√
CO3	√	√	√	√								√
CO4	√	√	√	√								√
CO5	√	√	√	√	√							

BM5403   **BIOMEDICAL INSTRUMENTATION**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES:
- To understand the basic theory of Bio potential Electrodes and Bio potential measurement.
- To design Bio potential amplifiers for acquisition of bio signals.
- To study the various non-electrical physiological parameter measurement and bio chemical measurements.

UNIT I   BIOPOTENTIAL ELECTRODES   9
Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half-cell potential, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT II   BIOPOTENTIAL MEASUREMENT   9
Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, block diagram. Measurements of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG.

UNIT III   BIOPOTENTIAL AMPLIFIER   8
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Artifacts and removal.

UNIT IV   NON ELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT   10
Temperature, respiration rate and pulse rate measurements, Plethysmography, Pulse oximetry, Blood Pressure: direct methods - Pressure amplifiers - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, oscillometric method, ultrasonic method. Blood flow - Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermodilution method.

UNIT V   BIOCHEMICAL MEASUREMENT   9
Biochemical sensors - pH, pO_2 and pCO_2, Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.
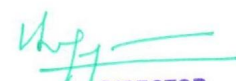
TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Describe the electrode behavior and circuit models.
CO2: Describe the fundamentals of Bio potential recording.
CO3: Design various bio amplifiers.
CO4: Measure various nonelectrical physiological parameters.
CO5: Measure various biochemical parameters.

TEXT BOOKS:
1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.

REFERENCES:
1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, 2nd Edition, 2015.
4. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√								√
CO2	√	√				√				√	√	√
CO3	√	√	√	√		√	√					√
CO4	√	√	√	√								√
CO5	√	√	√	√								√

HM5404   **HOSPITAL MANAGEMENT**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- The student should be made to understand the principles, practices and areas of application in Hospital management.

UNIT I   OVERVIEW OF HOSPITAL ADMINISTRATION   7
Distinction between Hospital and Industry, Challenges in Hospital Administration –Hospital Planning – Equipment Planning- AMC – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management

UNIT II   HUMAN RESOURCE MANAGEMENT IN HOSPITAL   9
Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT III   MARKETING RESEARCH & CONSUMER BEHAVIOUR   10
Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.

UNIT IV   HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES   10
Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.

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UNIT V   QUALITY AND SAFETY ASPECTS IN HOSPITAL   9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student should be able to:

CO1: Explain the principles, practices and areas of application in Hospital Management.
CO2: Understand the biomedical waste disposal concept.
CO3: Explain the importance of supportive services.
CO4: Comprehend the quality aspect specified by the international standards.
CO5: Knowledge on Hospital safety.

TEXT BOOKS:
1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI–4th Edition,2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management", TMH, New Delhi – 5th edition Reprint 2007.

REFERENCES:
1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York,1977.
2. Norman Metzger , "Handbook of Health Care Human Resources Management", Aspen Publication Inc. Rockville, Maryland, USA, 2nd Edition 1990.
3. Peter Berman, "Health Sector Reform in Developing Countries", Harvard University Press, 1995.
4. William A.Reinke, "Health Planning For Effective Management", Oxford University Press, 1988.
5. Blane, David, Brunner, Eric , "Health and Social organization: Towards a health policy for the 21st century", Calrendon Press, 1994.
6. Arnold D. Kalcizony & Stephen M.Shortell, "Health Care Management", 6th Edition, 2011.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√					√	√	√	√	√		√
CO2						√	√	√		√	√	√
CO3		√	√	√	√							
CO4	√		√		√		√	√			√	
CO5						√	√	√		√		√

BM5411   **BIOCHEMISTRY AND HUMANPHYSIOLOGY LABORATORY**   **L T P C**
                                                                       0 0 4 2

OBJECTIVES:
To provide practice on
- Estimation and quantification of biomolecules.
- Separation of macromolecules.
- Interpreting the metabolic changes in pathological conditions

LIST OF EXPERIMENTS:
1. Study of Human anatomy with A.D.A.M interactive online software
2. General tests for carbohydrates, proteins and lipids.

3.	Preparation of serum and plasma from blood.
4.	Estimation of blood glucose.
5.	Estimation of creatinine
6.	Estimation of urea
7.	Estimation of cholesterol
8.	Assay of SGOT/SGPT
9.	Separation of proteins by SDS electrophoresis
10.	Separation of amino acids by thin layer chromatography
11.	Separation of DNA by agarose gel electrophoresis
12.	ESR, PCV, MCH, MCV, MCHC, total count of RBCs and hemoglobin estimation.
13.	Differential count of different WBCs and blood group identification.
14.	Measurement of pH of solutions using pH meter.
15.	Ishihara chart for color blindness and Snellen"s chart for myopia and hyperopia - by letters reading and ophthalmoscope to view retina
16.	Weber and Rinne test for auditory conduction.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
CO1: Use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
CO2: Separate and analyze the importance of macromolecules.
CO3: Discuss the various blood parameters in pathological conditions.
CO4: Analyze, interpret and report the results of the laboratory experiments.
CO5: Implement experimental protocols and adopt to plan and carry out simple investigations.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		√	√	√			√	√	√		√	√
CO2		√	√	√			√	√	√		√	√
CO3		√	√	√			√	√	√		√	√
CO4		√	√	√			√	√	√		√	√
CO5		√	√	√			√	√	√		√	√

PROGRESS THROUGH KNOWLEDGE

**EC5413	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L T P C**
0 0 4 2

OBJECTIVES:
- To design digital logic and circuits
- To learn the function of different ICs
- To understand the applications of operation amplifier.
- To learn the working of multivibrators
- To design circuits for generating waveforms using ICs.

LIST OF EXPERIMENTS:
1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Design and analysis of active filters using opamp
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier using operational amplifier
6. RC and LC oscillators
7. Multivibrators using IC555 Timer
8. Study of logic gates, Half adder and Full adder
9. Encoder and BCD to 7 segment decoder

Attested

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10. Multiplexer and demultiplexer using digital ICs
11. Universal shift register using flip flops
12. Design of mod-N counter
13. Simulation and analysis of circuits using software

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Design Combinational Circuits using logic gates
CO2: Design and implement arithmetic circuits for different applications using opamp
CO3: Design Sequential Circuits using logic gates
CO4: Design wave form generators and analyse their characteristics
CO5: Simulate and analyse circuits using ICs

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√	√				√		√	√
CO2	√	√	√	√	√				√		√	√
CO3	√	√	√	√	√				√		√	√
CO4	√	√	√	√	√				√		√	√
CO5	√	√	√	√	√				√		√	√

BM5501   **DIAGNOSTIC AND THERAPEUTIC EQUIPMENT – I**   **L T P C**
3 0 0 3
OBJECTIVES:
- To understand the medical equipment used in the measurement of parameters related to cardiology and neurology
- To learn some of the cardiac assist devices.
- To understand the principle of biotelemetry
- To understand the function of various extracorporeal devices.

UNIT I   CARDIAC EQUIPMENT   9
Electrocardiograph - Normal and Abnormal Waveforms, Heart rate monitor, Heart rate variability, Holter Monitor, Cardiac Pacemaker- Internal and External Pacemaker, types, Batteries. AC and DC Defibrillator- Internal and External, types, Precautions.

UNIT II   NEUROLOGICAL EQUIPMENT   9
Multi channel EEG recording system, Clinical significance of EEG- Sleep patterns, Epilepsy, Evoked Potential –Visual, Auditory and Somatosensory, EEG Bio Feedback Instrumentation, Psychophysiological Measurements for testing sensory Responses, MEG (Magneto Encephalograph) -sensing principle and instrumentation

UNIT III   MUSCULAR EQUIPMENT   9
EMG - recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. EGG (Electro Gastro Graph), MMG (Magneto Myo Graph).

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UNIT IV   PATIENT MONITORING AND BIOTELEMETRY   9

Patient monitoring systems - ICU/CCU Equipment, Infusion pumps, bed side monitors, Central monitoring console. Architecture of Biotelemetry system – single and multi-channel Biotelemetry - Inductively coupled Biotelemetry - Optical Biotelemetry - readout formats. Concept of m-Health 2.0, Point of care devices – disposable hematology sensors.

UNIT V   EXTRA CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES   9

Need for heart lung machine, Functioning of bubble, Disc type and membrane type oxygenators, finger pump, roller pump. Hemodialyser unit, Peritoneal dialyser unit, Wearable artificial kidney. Lithotripsy, Cryogenic technique, Thermography – Recording Principle and clinical application. Tonometer, Auto Refractometer. Audiometer- Beksey's type, Pure tone, Speech. Galvanic skin resistance (GSR)- polygraph.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Apply different medical devices in the measurement of parameters related to cardiology, neurology.

CO2: Use various cardiac assist devices.

CO3: Measure and analyse signals generated by muscles.

CO4: Perform continuous monitoring and transmission of vital parameters.

CO5: Comprehend the need for special diagnostic and therapeutic devices and extra-corporeal devices.

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.

REFERENCES:

1. Myer Kutz, "Biomedical Engineering & Design Handbook: Volume 2", McGraw-Hill Publisher, 2nd Edition, 2009.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
4. Antony Y.K.Chan, "Biomedical Device technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√		√		√	√	√		√
CO2	√	√	√	√		√		√	√	√		√
CO3	√	√		√		√		√	√	√		√
CO4	√	√		√		√		√	√	√		√
CO5	√					√		√		√		√

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BM5502	**DISCRETE TIME SIGNAL PROCESSING**	**L T P C**
		3 0 0 3

OBJECTIVES:
- To understand about the continuous time and discrete time signals and systems.
- To learn the analysis of LTI systems using Laplace and Z transform.
- To represent the signal in frequency domain using FFT.
- To gain knowledge about the design of IIR and FIR filters.

UNIT I   **CLASSIFICATION OF SIGNALS AND SYSTEMS**   **9**

Continuous time signals - Discrete time signals – Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals – periodic and aperiodic signals, random signals, Energy & Power signals. Sampling Theorem. CT systems and DT systems - Classification of systems. Convolution, Correlation.

UNIT II   **ANALYSIS OF LTI SYSTEMS**   **9**

DTFS, DTFT and its properties, Frequency response. Analysis of Continuous Time LTI Systems – Laplace Transform - Properties of ROC– Inverse Laplace Transform. Analysis of Discrete Time LTI Systems – Z Transform - Properties of ROC– Inverse Z Transform

UNIT III   **DISCRETE FOURIER TRANSFORM**   **9**

DFT and its properties, magnitude and phase representation-Circular Convolution, Overlap-add and overlap-save methods. FFT - Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering.

UNIT IV   **DESIGN OF INFINITE IMPULSE RESPONSE FILTERS**   **9**

Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3rd order), Analog Transformation of prototype LPF to BPF /BSF/ HPF. Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z transform method - Realization structures for IIR filters – direct, cascade and parallel forms.

UNIT V   **DESIGN OF FINITE IMPULSE RESPONSE FILTERS**   **9**

Design of linear phase FIR filters - windowing and Frequency sampling methods. Realization structures for FIR filters – Transversal and Linear phase structures, Comparison of FIR and IIR. Introduction to DSP processor. Introduction to Multirate signal Processing – Decimation and Interpolation.

TOTAL: 45PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Describe the continuous time and discrete time signals and systems.
CO2: Analyze the signals in both continuous time and discrete time
CO3: Compute the spectrum of any signal
CO4: Design IIR filter to process real world signals
CO5: Design FIR filter to process real world signals

TEXT BOOKS:
1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2nd Edition, 2015.
2. S. Haykin and B. Van Veen, "Signals and Systems", Wiley, 2nd Edition, 2007.
3. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, 4th Edition, 2014
4. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", Indian Reprint, Pearson, 3rd Edition, 2014.

REFERENCES:
1. H P Hsu, "Signals and Systems, Schaum's Outlines", Tata McGraw Hill, 3rd Edition, 2013.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, 2nd Edition, 2009.
3. John Alan Stuller, "An Introduction to Signals and Systems", Cengage Learning, 2007
4. Emmanuel Ifeachor, Barrie Jervis, "Digital Signal Processing- A practical approach", Pearson, 2nd Edition, 2002.

5. M. H. Hayes, "Digital Signal Processing, Schaum's outlines", Tata McGraw Hill, 2nd Edition, 2011.
6. Sanjit K. Mitra, "Digital Signal Processing: A Computer-Based Approach", McGraw Hill Education, 4th Edition, 2013.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√							√
CO2	√	√	√		√							√
CO3	√	√	√	√	√							√
CO4	√	√	√	√	√							√
CO5	√	√	√	√	√							√

BM5503   **PATHOLOGY AND MICROBIOLOGY**   **L T P C**
                                                                          2 0 2 3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To understand the structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.
- To practice on chemical and structural examinations, histopathological examinations etc.

UNIT I   CELL DEGENERATION, REPAIR AND NEOPLASIA   9
Cell injury and necrosis, apoptosis, intracellular accumulations, cellular adaptations of growth and differentiation. Inflammation and repair including fracture healing, neoplasia, benign and malignant tumours, spread of tumours and biopsy. Visualization of histopathological slides of benign and malignant tumours.

UNIT II   FLUID AND HEMODYNAMIC DERRANGEMENTS   9
Edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-bleeding disorders, leukaemias, lymphomas. Visualization of hematology slides of anemia and leukemia (acute and chronic). Bleeding time and clotting time.

UNIT III   MICROSCOPES   9
Light microscope – bright field, dark field, phase contrast, fluorescence, electron microscope (TEM& SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining. Staining techniques – hematoxylin and eosin staining.

UNIT IV   MICROBIAL CULTURES   9
Morphological features and structural organization of bacteria, growth curve, sterilization techniques – physical and chemical methods, identification of bacteria, culture media and its types, culture techniques and observation of culture. Demonstration on sterilization techniques.

UNIT V   IMMUNOLOGY   9
Natural and artificial immunity, phagocytosis, inflammation, antibodies, antigen and antibody reactions, hypersensitivity, immunological techniques- immune diffusion, immuno electrophoresis, radioimmunoassay and enzyme linked immuno sorbent assay, monoclonal antibodies. Disease caused by bacteria and protozoa. Visualization of slides of malarial parasites, microfilaria and leishmania donovani.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to:
CO1: Analyze structural and functional aspects of living organisms.

CO2: Explain the function of microscopes.

CO3: Discuss on the importance of public health.

CO4: Describe treatment methods involved in curing the pathological diseases.

CO5: Perform practical experiments on tissue processing, sterilization techniques and staining processes.

TEXT BOOKS:
1. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of diseases", WB Saunders Co. 7th Edition, 2005.
2. Harsh Mohan, "Text book of Pathology". Jaypee Brothers Medical publishers private Limited, 7th Edition, 2014.

REFERENCES:
1. Underwood JCE, "General and Systematic Pathology", Churchill Livingstone, 3rd, Edition, 2000.
2. Ananthanarayanan, "Microbiology", Panicker University press. 9th Edition, 2013
3. Dubey RC and Maheswari DK , "Microbiology", S Chand Publications, 3th Edition, 2010
4. Prescott, Harley,Klein, "Microbiology", Mc Graw Hill, 9th Edition, 2013.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√			√	√	√						√
CO2	√				√							√
CO3	√					√	√	√		√		√
CO4	√	√	√	√		√	√	√				√
CO5	√	√			√					√		√

BM5511	DIGITAL SIGNAL PROCESSING LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:
1. To implement generation of sequences
2. To realize Linear and Circular Convolution
3. To design and realize FIR and IIR filters
4. To implement signal processing algorithms using digital signal processor

DSP Processor Implementation
1. Study of architecture of Digital Signal Processor
2. MAC operation using various addressing modes
3. Implementation of difference equations
4. Linear Convolution
5. Circular Convolution
6. Waveform generation

MATLAB / Equivalent Software package
7. Generation of sequences
8. Linear and Circular Convolutions
9. DFT
10. FIR filter design
11. IIR filter design
12. Finite word length effects

13. Decimation and Interpolation

TOTAL: 60 PERIODS

LAB REQUIREMENTS:
TMS 320C5x / TMS 320C6x Kits – 15 Nos.
MATLAB or Equivalent S/w – 15 User License

COURSE OUTCOMES:
At the end of the course, students will be able to:
CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Carry out simulation of DSP systems.
CO3: Demonstrate their abilities towards DSP processor based implementation of DSP systems.
CO4: Analyze Finite word length effect on DSP systems.
CO5: Demonstrate the applications of FFT to DSP.
CO6: Implement adaptive filters for various applications of DSP.

BM5512	BIO MEDICAL INSTRUMENTATION LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:
- To study and design Bio amplifiers.
- To provide hands on training on Measurement of physiological parameters.

LIST OF EXPERIMENTS:
1. Design of low noise pre-amplifier.
2. Design of ECG amplifier and Measurement of heart rate.
3. Design of EMG amplifier.
4. Measurement of heart sounds using PCG.
5. Measurement of pulse-rate using Photo transducer.
6. Measurement of respiration rate.
7. Measurement of blood flow velocity using ultrasound transducer.
8. Measurement of blood pressure using sphygmomanometer.
9. Study of characteristics of optical Isolation amplifiers.
10. Measurement of vital parameters using Patient Monitoring System
11. Study of Biotelemetry

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, students will be able to:
CO1: Design the amplifier for Bio signal measurements
CO2: Measure heart rate and heart sounds.
CO3: Record and analyze pulse rate and respiration rate
CO4: Measure blood pressure and blood flow
CO5: Design isolation amplifier

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√			√	√	√				√		√
CO2	√			√						√	Attested	
CO3	√				√	√	√			√		√
CO4	√	√	√	√		√	√	√		√		√
CO5	√	√		√						√		

BM5601   **DIAGNOSTIC AND THERAPEUTIC EQUIPMENT - II**   **L T P C**
                                                                              3 0 0 3

OBJECTIVES:
- Gain knowledge about measurements of parameters related to respiratory system
- Understand Biomedical Laser principles and applications.
- Understand different types and uses of diathermy units.
- Know the principles of ultrasound and its use in diagnosis
- Know the importance of patient safety against electrical and laser hazards.

UNIT I   RESPIRATORY MEASUREMENT AND ASSIST SYSTEMS   10
Lung Volume and vital capacity, Spirometer, measurements of residual volume. pneumotachometer – Airway resistance measurement, Whole body plethysmography. Intra-Alveolar and Thoracic pressure measurements, Apnea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT II   LASER BASED EQUIPMENTS   8
Lasers in Medicine – Types, Tissue reactions. Lasers in ophthalmology, Flow Cytometry, Endoscopy, Minimally Invasive Laparoscopy, Laser Microirradiation, Laser Doppler Velocimetry, Neurosurgical Laser Techniques.

UNIT III   DIATHERMY   9
IR and UV lamp - application. Need for different diathermy units, Short wave diathermy, ultrasonic diathermy, Microwave diathermy. Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures.

UNIT IV   ULTRASOUNDEQUIPMENT   9
Diagnosis: Tissue Reaction, Basic principles of Echo technique, display techniques A, B and M mode, B Scan, Application of ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, abdomen, obstetrics and gynecology, ophthalmology.

UNIT V   PATIENT SAFETY   9
Physiological effects of electricity – important susceptibility parameters – Macro shock, Micro shock hazards, Patient's electrical environment, GFI units, Earthing Schemes. Electrical safety codes and standards, Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electrical safety of medical equipment, Biomedical Laser Safety.

                                                                    TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1: Explain about measurements of parameters related to respiratory system .
CO2: Appreciate the use of advanced laser technology in diagnosis and minimally invasive therapies.
CO3: Analyze different types of diathermy units.
CO4: Understand the concepts of ultrasound equipment.
CO5: Identify the electrical hazards and Implement methods of patient safety.

TEXT BOOKS:
1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurements", Pearson Education India; 2nd Edition, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
3. Leon Goldman, "The Biomedical Laser: Technology and Clinical applications", Springer – Verlag Newyork Inc., 2013.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.

2. Richard Aston, "Principles of Biomedical Instrumentation and Measurement" Merril Publishing Company, 1990.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley and Sons, Reprint 2008.
4. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th edition, 2009.
5. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design" – McGraw-Hill Publisher, 2003.
6. Antony Y.K.Chan, "Biomedical Device technology, Principles and design'', Charles Thomas Publisher Ltd, Illinois, USA, 2008.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2	√					√	√	√				√
CO3	√					√	√	√				√
CO4	√			√		√	√	√				√
CO5	√					√	√	√				√

BM5602　　　　　　　　　**RADIOLOGICAL EQUIPMENT**　　　　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

OBJECTIVES:
- To understand generation of x-rays and its applications in imaging.
- To learn different types of radio diagnostic techniques.
- To know techniques used for visualizing different sections of the body
- To learn radiation therapy methodologies and the radiation safety.

UNIT I　　　　**MEDICAL X-RAY EQUIPMENT**　　　　　　　　　　　**9**
Nature of X-rays, X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, collimator, Bucky Grid, power supply. Digital Radiography-discrete digital detectors, storage phosphor and film scanning. Fluoroscopy - X-ray Image Intensifier tubes – Digital Fluoroscopy. Angiography - cine Angiography, Digital subtraction Angiography. Mammography.

UNIT II　　　　**COMPUTED TOMOGRAPHY**　　　　　　　　　　　**9**
Principles of tomography, CT Generations - X- Ray sources, collimation, X- Ray detectors, Viewing systems, spiral CT scanning, ultra fast CT scanners. Image reconstruction techniques- back projection and iterative method.

UNIT III　　　　**MAGNETICRESONANCE IMAGING**　　　　　　　　**9**
Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radiofrequency wave, rotation and precession. Induction of magnetic resonance signals – bulk Magnetization, Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), Gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components. fMRI.

UNIT IV　　　　**NUCLEAR IMAGING SYSTEM**　　　　　　　　　　**9**
Radio Isotopes- alpha, beta, and gamma radiations. Radiopharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors. Gamma camera- Principle of operation, collimator, photo multiplier tube, X-Y positioning circuit, pulse height Analyzer. Principles of SPECT and PET.

UNIT V　　　　**RADIATION THERAPY AND RADIATION SAFETY**　　　　**9**
Effects of radiation- direct and indirect. Radiation therapy – linear accelerator, Tele gamma Machine. Recent Techniques in radiation therapy - Stereotaxic Radiosurgery, Stereotaxic

Radiotherapy, 3D CRT, IMRT, IGRT and Cyber knife. Radiation measuring instruments-Dosimeter, film Badges, Thermo Luminescent dosimeters- electronic dosimeter. Radiation protection in medicine- radiation protection principles, ICRP,AERB.

TOTAL: 45 PERIODS.

OUTCOMES:
At the end of the course, student will be able to
CO1: Discuss the principle and working of various radiography equipment.
CO2: Explain the tomography concept and image reconstruction techniques.
CO3: Describe the basic principle and working of Magnetic resonance imaging technique.
CO4: Explain the concept of nuclear imaging techniques and radiation detectors.
CO5: Demonstrate the effects of radiation, radiation safety and the principle of Radio therapy
         techniques.

TEXT BOOKS:
1. Steve Webb, "The Physics of Medical Imaging'', Adam Hilger,Philadelpia, 1988.
2. Jerrold T.Bushberg, J.Anthony Seibert, Edwin M.Leidholdt,Jr, John M.Boone, 'The Essential Physics of Medical Imaging'', Lippincott Williams and Wilkins, 3rd Edition, 2012.
3. R.Hendee and Russell Ritenour, "Medical Imaging Physics", William,Wiley- Liss, 4th Edition, 2002.

REFERENCES:
1. Gopal B. Saha, "Physics and Radiobiology of Nuclear Medicine'', Springer, 3rd Edition 2006.
2. B.H.Brown, PV Lawford, RH Smallwood, DR Hose, DC Barber, "Medical physics and Biomedical Engineering'', - CRC Press,1999.
3. Myer Kutz, "Standard handbook of Biomedical Engineering and design", McGraw Hill, 2003.
4. P.Ragunathan, "Magnetic Resonance Imaging and Spectroscopy in Medicine concepts and Techniques'', Orient Longman,2007.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√				√	√	√			√	√
CO2	√	√		√	√	√	√	√			√	√
CO3	√	√		√	√	√	√	√			√	√
CO4	√	√		√	√	√	√	√			√	√
CO5	√	√	√	√	√	√	√				√	√

EC5551	MICROPROCESSORS AND MICROCONTROLLERS	L T P C
		3 0 0 3

OBJECTIVES:
- To study the architecture of 8085, 8086 , 8051and ARM.
- To study the addressing modes and instruction set of 8085, 8086 8051and ARM .
- To explore the need and use of Peripherals and Interfacing.
- To develop skill to explore system design technique .

UNIT I   8- BIT and 16 - BIT MICROPROCESSOR.   9
8085 Architecture, Instruction set, Addressing modes, Interrupts, Timing diagrams, Memory and I/O interfacing. 8086 Architecture, Instruction set and programming, Minimum and Maximum mode configurations.

Attested

UNIT II   PERIPHERALS AND INTERFACING   9
Programmable Peripheral Interface (8255), Keyboard display controller (8279), ADC0808 and DAC0808 Interface, Programmable Timer Controller (8254), Programmable interrupt controller (8259), Serial Communication Interface (8251).

UNIT III   MICROCONTROLLER   9

8051 – Architecture, Special Function Registers (SFRs), Instruction set, Addressing modes, Assembly language programming, I/O Ports, Timers / counters, Interrupts and serial communication.

UNIT IV   MICROCONTROLLER BASED SYSTEM DESIGN   9

Interfacing to: matrix display, (16x2) LCD, high power devices, optical motorshaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol.

UNIT V   32- BIT ARM PROCESSOR   9

RISC Vs CISC Architecture, ARM Processor Architecture, ARM Core data flow model,   Barrel Shifter,   ARM processor modes and families,   pipelining , ARM   instruction Set and its Programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to relate any architecture and assembly language for a processor.
CO2: Ability to comprehend the architectural and pipelining concepts for Microprocessors.
CO3: Ability to design and deploy the Interfacing peripherals in real time scenario.
CO4: Ability to discriminate different microprocessor and microcontroller and its special function
       registers.
CO5: Ability to design, develop and trouble shoot microcontroller based system.

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Penram International Publishing reprint, 6th Edition, 2017.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Tata McGraw Hill, Revised 2nd Edition 2006, 11th reprint 2015.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2008, 12th impression 2018.
2. Krishna Kant, "Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096", PHI, 2007, 7th Reprint, 2015.
3. Kenneth J. Ayala., "The 8051 Microcontroller, Thompson Delmar Learning", 3rd Edition, 2012.
4. A.K. Ray, K.M. Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw-Hill, 2nd Edition, 2010.
5. Barry B. Brey, "The Intel Microprocessors Architecture, Programming and Interfacing", Pearson Education, 2007, 2nd impression, 2010.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1							2	
CO2	1	2	2	1							1	
CO3		2	3	2							2	2
CO4	1	2	3	3							1	
CO5	1	3	3	3	1						2	3

BM5611   DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY   L T P C
0 0 4 2

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OBJECTIVES:

- To provide practice on recording and analysis of different Biopotentials.

- Study the function of different therapeutic equipments.

LIST OF EXPERIMENTS:
1. Recording and analysis of ECG signals.
2. Recording and analysis of EEG signals.
3. Recording and analysis of EMG signal and plotting of fatigue characteristics.
4. Simulation of ECG – detection of QRS complex and heart rate
5. Study of shortwave and ultrasonic diathermy.
6. Electrical safety measurements.
7. Analysis of characteristics of surgical diathermy.
8. Measurement of Respiratory parameters using spirometry.
9. Measurement of GSR.
10. Recording of Audiogram.
11. Study of muscle stimulator.
12. Preprocessing Biosignals using virtual instrumentation platform.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student will be able to
- Record and Analyse physiological signal.
- Describe the functional characteristics of therapeutic equipment.
- Test the safety of medical equipment.
- Study the effect of stimulators.
- Process Biosignals in VI Platforms.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√				√	√	√	√	√	√	√
CO2	√	√		√	√	√	√	√	√	√	√	√
CO3	√	√		√	√	√	√	√	√	√	√	√
CO4	√	√		√	√	√	√	√	√	√	√	√
CO5	√	√		√	√	√	√	√	√	√	√	√

EC5561	MICROPROCESSOR AND MICROCONTROLLER INTERFACING LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study introduce the programming language of 8085, 8086 and 805.
- To develop skill in program writing for microprocessors and controllers.
- To introduce microprocessor and microcontroller based system design.
- To impart knowledge on embedded S/W development.

LIST OF EXPERIMENTS:
Assembly Language Programming of 8085 and 8086.
1. Programs for 8 / 16 bit Arithmetic, Sorting, Searching and String operations,
2. Programs for Digital clock, Interfacing ADC and DAC
3. Interfacing and programming 8279, 8259, and 8253.
4. Serial Communication between two microprocessors kits using 8251.
5. Interfacing Stepper Motor, Speed control of DC Motor
6. Parallel communication between two microprocessors kits using Mode 1 and Mode 2 of 8255.
7. Macro assembler Programming for 8086.

8051 based experiments using assembly language and C programming:
8. Programming using Arithmetic, Logical and Bit Manipulation instructions of the 8051 microcontroller.
9. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller.
10. Interfacing – DAC and ADC and 8051 based temperature measurement
11. Interfacing – LED and LCD
12. Interfacing – Stepper motor and traffic light control system
13. Communication between 8051 Microcontroller kit and PC.
14. Programming ARM processor using Embedded C.

`   **TOTAL: 60 PERIODS**

COURSE OUTCOMES:
CO1 : Ability to develop assembly language program for microprocessors and microcontrollers.
CO2: Ability to comprehend the architectural and pipelining concepts for Microprocessors.
CO3: Ability to interface peripherals, sensors and actuators and in embedded systems.
CO4: Ability to design microprocessor / microcontroller based system.
CO5: Ability to design , develop and trouble shoot microcontroller based system.

	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1	1							2	
CO2	1	3	3	3							3	3
CO3	1	3	3	3							3	3
CO4	1	3	3	3							3	3
CO5	1	3	3	3							3	3

BM5701   **BIOMECHANICS**   **L T P C**
                                                                                        3 0 0 3

OBJECTIVES:
- To study about the mechanics involved with various physiological systems.
- To gain knowledge in deriving the mathematical models related to blood vessels.

UNITI   INTRODUCTION   **9**
Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Bio fluid mechanics, flow properties of blood. Anthropometry.

UNIT II   MECHANICS OFPHYSIOLOGICALSYSTEMS   **9**
Heart valves, power developed by the heart, prosthetic valves. Constitutive equations for soft tissues, dynamics of fluid flow in cardiovascular system and effect of vibration - shear stresses in extra-corporeal circuits.

UNIT III   ORTHOPAEDIC MECHANICS   **9**
Mechanical properties of cartilage, diffusion properties of articular cartilage, mechanical properties of bone, kinetics and kinematics of joints, Lubrication of joints.

UNIT IV   MATHEMATICAL MODELS   **9**
Introduction to Finite Element Analysis, Mathematical models - pulse wave velocities in arteries, determination of in-vivo elasticity of blood vessel, dynamics of fluid filled catheters.

UNIT V   ORTHOPAEDICAPPLICATIONS   **9**
Dynamics and analysis of human locomotion - Gait analysis (determination of instantaneous joint reaction analysis), occupant response to vehicular vibration. Mechanics of knee joint during standing and walking.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√									√
CO2	√	√	√		√	√	√	√	√	√		
CO3	√	√			√	√	√	√	√	√		√
CO4	√	√	√		√	√	√	√	√	√		√
CO5	√	√	√		√	√	√	√	√	√		√

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Understand the use of mechanics in medicine.
CO2: Understand the mechanics of physiological systems.
CO3: Distinguish the reason for abnormal patterns.
CO4: Analyze the biomechanical systems using mathematical models.
CO5: Design and develop the models specific to orthopedic applications.

TEXT BOOKS:
1. Y.C.Fung,-Bio-Mechanics, "Mechanical Properties ofTissues",Springer-Verilog,1998.
2. C. Ross Ether and Craig A.Simmons, "Introductory Biomechanics from cells to organisms", Cambridge University Press, New Delhi, 2009.

REFERENCES:
1. Susan J Hall, "Basics of Biomechanics", Mc Graw Hill Publishing.co. New York, 5th Edition, 2007.
2. Dhanjoo N.Ghista, "Orthopaedic Mechanics", Academic Press, 1990.
3. Joseph D.Bronzino, "Biomedical Engineering Fundamentals", Taylor& Francis, 2006.
4. John Enderle, Susanblanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", Elsevier, 2005.
5. B.H.Brown, PV Lawford, RH Small wood, DR Hose, Dc Barber, "Medical Physics and Biomedical Engineering", CRC Press, 1999.
6. Dhanjoo N.Ghista, "Bio-mechanics of Medical Devices", Marcel Dekker, 1980.
7. Haufred Clynes, "Bio-medical Engineering Systems", McGrawHill,1998.

PROGRESS THROUGH KNOWLEDGE

BM5702 **PRINCIPLES OF DIGITAL IMAGE PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:
- To study the formation of an image and its acquisition
- To introduce the use and application of transforms in image processing
- To study techniques for improving quality of information in corrupted images
- To introduce schemes for compressing images to save storage space

UNIT I **DIGITAL IMAGE FUNDAMENTALS** **9**
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**
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
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
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
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

TOTAL :45 PERIODS

COURSE OUTCOMES
At the end of the course, the student will be able to
CO1: Process color images and compute image transforms.
CO2: Preprocess the image using image enhancement and filtering techniques.
CO3: Restore the degraded images.
CO4: Segment the region of interest in images.
CO5: Apply various compression techniques on images.

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.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√					√		√
CO2	√	√	√		√					√		√
CO3	√	√	√		√					√		√
CO4	√	√	√		√					√		√
CO5	√	√	√		√					√		√

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

Attested

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BM5712   **MEDICAL IMAGE PROCESSING LABORATORY**   **L T P C**
                                                                      0 0 4 2

OBJECTIVES:
- To study the various aspects of image processing techniques for medical images

LIST OF EXPERIMENTS:
1. Display of color and grayscale Images.
2. Conversion between color spaces
3. Histogram Equalization.
4. Spatial filtering
5. Non-linear Filtering.
6. Edge detection using Operators.
7. 2-D DFT and DCT.
8. Filtering in frequency domain.
9. DWT of images.
10. Segmentation using watershed transform.
11. Steganography
12. Feature extraction in medical images.
13. Medical Image Compression techniques.
14. Medical image fusion
15. Study of DICOM standards.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course the student will be able to
CO1: Apply filtering techniques to medical images.
CO2: Apply segmentation techniques.
CO3: Perform Encryption in image.
CO4: Identify and perform fusion techniques.
CO5: Understand standards in Image storage and communication.

REFERENCES:
1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, " Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	√	√	√		√				√	√		√
CO2	√	√	√		√				√	√		√
CO3	√	√	√		√				√	√		√
CO4	√	√	√		√				√	√		√
CO5	√	√	√		√				√	√		√

BM5001   **PATTERN RECOGNITION AND NEURAL NETWORKS**   **L T P C**
                                                                      3 0 0 3

OBJECTIVES:
- To study the fundamentals of pattern recognition and its application.
- To learn algorithms suitable for pattern classification.
- To understand applications of pattern recognition and classification in image processing and computer vision.

UNIT I   SUPERVISED LEARNING   **9**
Overview of Pattern recognition, Types of Pattern recognition, Parametric and Nonparametric approach, Bayesian classifier, Discriminant function, non-parametric density estimation, histograms, kernels, window estimators, k- nearest neighbor classifier, estimation of error rates.

UNIT II   UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS   9
Unsupervised learning- Hierarchical clustering- Single-linkage Algorithm, Complete – linkage Algorithm, Average - Linkage Algorithm and Ward's method. Partitional clustering- Forgy's Algorithm and k-means algorithm. Case studies.

UNIT III   INTRODUCTION TO NEURAL NETWORK   9
Elementary neurophysiology and biological neural network –Artificial neural network – Architecture, biases and thresholds, Hebb net, Perceptron, Adaline and Madaline.

UNIT IV   BACK PROPAGATION NETWORK AND ASSOCIATIVE MEMORY   9
Back propagation network, generalized delta rule, Bidirectional Associative memory, Hopfield Network

UNIT V   NEURAL NETWORKS BASED ON COMPETITION   9
Kohonen Self organizing map, Learning Vector Quantisation, Counter Propagation network, Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to
CO1: Classify patterns using statistical pattern classifier
CO2: Perform unsupervised classification using clustering techniques.
CO3: Explain the fundamentals of neural networks.
CO4: Design Back Propagation and Hopfield network.
CO5: Perform classification using competitive neural networks.
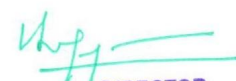
TEXT BOOKS:
1. Duda R.O, Hart P.G, "Pattern Classification and scene analysis'', Wiley Edition, 2000.
2. Earl Gose, Richard Johnsonbaugh Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt Ltd., New Delhi,1999.
3. Freeman J. A., and Skapura B.M, "Neural networks, algorithms, applications and programming techniques", Addison- Wesley,2003

REFERENCES:
1. Hagan, Demuth and Beale, "Neural Network Design", Vikas Publishing House Pvt Ltd., New Delhi, 2002.
2. Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches", John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2005.
3. Laurene Fausett, "Fundamentals of Neural Networks- Architectures, Algorithms and Application", Prentice Hall, 1994.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√							√
CO2	√	√	√		√							√
CO3	√	√	√		√							√
CO4	√	√	√		√							√
CO5	√	√	√		√							√

BM5002   **MEDICAL INFORMATICS**   **L T P C**
                                                                         3 0 0 3

OBJECTIVES:
- To teach ICT applications in medicine with an introduction to health informatics.
- To understand the theories and practices adopted in Hospital Information Systems in the light of medical standards, medical data formats and recent trends in Hospital Information Systems.

UNIT I   MEDICAL INFORMATICS   9
Introduction - Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and off – line services - History taken by computer, Dialogue with the computer.

UNIT II   MEDICAL STANDARDS   9
Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA – Electronics Patient Records –Healthcare Standard Organizations – JCAHO (Join Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics.

UNIT III   MEDICAL DATA ACQUISITION AND STORAGE   9
Plug-in Data Acquisition and Control Boards – Data Acquisition using Serial Interface - Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System - PACS , Data mining.

UNIT IV   HEALTH INFORMATICS   9
Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics -Education and Training.

UNIT V   RECENT TRENDS IN MEDICAL INFORMATICS   9
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment - Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine

                                                                TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able:
CO1: To discuss about health informatics and different ICT applications in medicine.
CO2: To explain the function of Hospital Information Systems.
CO3: To appreciate and adopt medical standards.
CO4: Understand the virtual reality tools.
CO5: Understand the concept and need of different information systems.
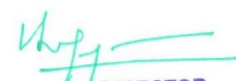
TEXT BOOKS:
1. R.D.Lele, "Computers in Medicine: Progress in Medical Informatics'', Tata McGraw Hill Publishing computers Ltd, New Delhi, 2005.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, New Delhi, 2003.
3. N.Mathivanan, "PC-Based Instrumentation'', Prentice Hall of India Pvt Ltd – New Delhi, 2007.
4. Yi – Ping Phoebe Chen, "Bioinformatics Technologies'', Springer International Edition, New Delhi, 2007.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2			√	√	√						√	√
CO3					√	√		√		√		√
CO4			√	√	√	√	√					√
CO5			√	√	√						√	√

BM5003	MEDICAL ETHICS AND STANDARDS	L T P C
		3 0 0 3

OBJECTIVES:

- Students will be able to know about the legal and ethical principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.
- Professional ethics to be followed by Biomedical Engineers.
- Patient safety and regulatory aspects followed in hospitals

UNIT I   INTRODUCTION TO MEDICAL ETHICS   9

Definition of Medical ethics, Scope of ethics in medicine, International code of Ethics for occupational health professionals,   Ethical Theories --Deontology & Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Role of ethics in Healthcare workplace – Autonomy, Non-Malfeasance, Beneficence, Veracity, Justice, OSHA, Decision Model for Healthcare Dilemmas-Applications of Plus decision making model.

UNIT II   CODE OF ETHICS FOR BIOMEDICAL ENGINEERS   9

Bioethics-The principle of Double effect, Code of Hammurabi, Engineering Competence, Ethical Issues in biomedical research-Cloning and stem cell research, Neuro ethics, Organ Transplantation, Hypothetico-deductive method, Research Conflict of Interest. Medical device failure- Five failure types, Bio-terrorism, Sustainable Bioethics-Life cycles and Concurrent Engineering, Environmental Health – case studies

UNIT III   MEDICAL DEVICE SAFETY   9

Shared Responsibility for Medical device safety. WHO – International Health Regulations (IHR), Stages of regulatory control of medical devices, Ethics committee- its members and functions, Global Harmonization Task Force (GHTF). Quality systems requirement –ISO, Voluntary and mandatory standards, Collateral Standards- EMC radiation protection &programmable medical device system, Particular Standards-type of medical device

UNIT IV   REGULATORY STANDARDS FOR MEDICAL DEVICE MAINTENANCE   9

International Standards- Medical Device Directive 93/42/EEC, Medical Electrical Equipment ISO 60601, Safety Testing of Medical Devices ISO 62353, Medical Device Inspection ISO17020. Indian Standards – National Health Mission , Biomedical Equipment Management and Maintenance Program (BMMP), ISO 9001-2008, AERB Compliance – Radiation protection AE(RP)R-2004, Safety Code AE/RF-MED/SC-3.

UNIT V   HOSPITAL ACCREDITATION AND SAFETY STANDARDS   9

Accreditation - JCI   Accreditation & its Policies.Life Safety Standards- Protecting Occupants, Protecting the Hospital and Individuals from Fire, Smoke, and Heat.Managing Hazardous Medical Material and Waste, Laboratory and Radiation safety, Health and safety hazards of shift work. Patient Safety – Human factors, Reliability, Evidence based Medicine, Root cause Analysis.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:
Upon completion of this course the student should be able to: demonstrate a measurable increase in their knowledge, skills and abilities related to
CO1: Legal and professional guidelines for the health professions
CO2: Social responsibility in healthcare systems
CO3: Bioethics and engineers role
CO4: Medical device maintenance
CO5: Understand safety aspects.

TEXTBOOKS:
1. William Charney, "Handbook of Modern Hospital Safety'', CRC Press, 2nd Edition, 2009.
2. Almira Badnjevic, Mario Cifrek, Ratko Magjarevic, Zijad Dzemic, "Inspection of Medical Devices: For Regulatory Purposes", Springer Nature, 2018.
3. Domiel A Vallero , "Biomedical Ethics for Engineers", Elsevier Pub.1st Edition, 2007.

REFERENCES:
1. Eileen E.Morrison, "Ethics in Health Administration: A Practical Approach for Decision Makers'',Jonnes and Bartletts' Publication, 2nd Edition, 2011.
2. Robert M Veatch, "Basics of Bio Ethics'', Prentice- Hall, Inc., 2nd Edition, 2003.
3. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HCPro, Inc., 2010.
4. Joint Commission Accreditation Standards for Hospitals ,2nd Edition, 2003.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√				√		√				√
CO2		√				√	√	√		√		√
CO3		√				√	√	√	√	√		√
CO4	√	√	√		√	√			√		√	√
CO5	√	√			√		√	√				√

BM5004   **COMMUNICATION ENGINEERING**   **L T P C**
                                                                      3 0 0 3
OBJECTIVES:
- To study the various analog and digital modulation techniques
- To study the principles behind various error control coding
- To study the various digital communication techniques

UNIT I   ANALOG MODULATION   9
Amplitude Modulation – AM, DSBSC, SSBSC, VSB – Angle modulation – PM and FM – Modulators and Demodulators.

UNIT II   RECEIVER CHARACTERISTICS   9
Noise sources and types – Noise figure and noise temperature – Noise in cascaded systems – Single tuned receivers – Super heterodyne receivers.

UNIT III   INFORMATION THEORY   9
Measure of information – Entropy – Source coding theorem – Discrete memoryless channels – lossless, deterministic, noiseless, BEC, BSC – Mutual information – Channel capacity – Shannon-Fano coding, Huffman Coding, run length coding, LZW algorithm.

UNIT IV   BANDPASS SIGNALING   9
Geometric representation of signals – Correlator and matched filter – ML detection – generation and detection, PSD, BER of coherent BPSK, BFSK, QPSK – Principles of QAM – Structure of non-coherent receivers – BFSK, DPSK

UNIT V   ERROR CONTROL CODING TECHNIQUES   9
Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes (CRC) – Convolutional codes – Viterbi decoding (Soft/Hard decision decoding).

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Apply analog modulation techniques.
CO3: Apply digital modulation techniques.
CO4: Knowledge on various types of noises during transmission.
CO5: Analyze various error control coding techniques.

TEXT BOOKS:
1.   H Taub, D L Schilling, G Saha, "Principles of Communication Systems", TMH, 3rd Edition, 2007.
2.   S. Haykin , "Digital Communications", John Wiley, 2005.

REFERENCES:
1.   B.P.Lathi, "Modern Digital and Analog Communication Systems'', Oxford University Press, 3rd Edition, 2007.
2.   H P Hsu, Schaum "Outline Series, Analog and Digital Communications", TMH, 2006
3.   B.Sklar, "Digital Communications Fundamentals and Applications", Pearson Education, 2nd Edition, 2007.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2	√	√	√		√							√
CO3	√	√	√									√
CO4	√	√	√									√
CO5	√	√	√		√			√				√

BM5005   **BIO SIGNAL PROCESSING**   **L T P C**
                                                                     3 0 0 3

OBJECTIVES:
- To study the characteristics of different biosignals
- To learn linear and non-linear filtering techniques to extract desired information
- To understand various techniques for automated classification and decision making to aid diagnosis

UNIT I   BIOSIGNAL AND SPECTRAL CHARACTERISTICS   9
Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II   TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION   9

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III   ADAPTIVE FILTERING AND WAVELET DETECTION   9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV   BIOSIGNAL CLASSIFICATION AND RECOGNITION   9

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT V   TIME FREQUENCY AND MULTIVARIATE ANALYSIS   9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA,ICA.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course, the students will be able to
CO1: Preprocess the Biosignals.
CO2: Analyze biosignals in time domain & to estimate the spectrum.
CO3: Apply wavelet detection techniques for biosignal processing.
CO4: Classify Biosignals using neural networks and statistical classifiers.
CO5: Extract the features using multivariate component analysis.

TEXT BOOKS:
1. Arnon Cohen, "Bio-Medical Signal Processing Vol I and Vol II", CRC Press Inc., Boca Rato, Florida, 1999.
2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis-A case study approach", Wiley, 2nd Edition, 2016.

REFERENCES:
1. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal processing- A Practical Approach'',Pearson education Ltd., 2004.
3. Raghuveer M. Rao and Ajith S.Bopardikar, "Wavelets transform – Introduction to theory and its applications", Pearson Education, India, 2000.
4. K.P.Soman, K.Ramachandran, "Insight into wavelet from theory to practice", PHI, New Delhi, 3rd Edition, 2010.
5. John L.Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications'', Taylor& Francis Inc, 2004.
6. Kayvan Najarian and Robert Splerstor, "Biomedical signals and Image processing'', CRC – Taylor and Francis, New York, 2nd Edition, 2012.
7. D.C.Reddy, "Biomedical Signal Processing – Principles and Techniques'', Tata McGraw-Hill Publishing Co. Ltd, 2005.
8. Gari D. Clifford, Francisco Azuajeand Patrick E.McSharry, "Advanced Methods and Tech for ECG Data Analysis", ARTECH House, Boston, 1st Edition, 2006.

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COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√			√	√			√
CO2	√	√	√		√			√	√			√
CO3	√	√	√		√			√	√			√
CO4	√	√	√		√			√	√			√
CO5	√	√	√		√			√	√			√

BM5006   **BIO MATERIALS AND ARTIFICIAL ORGANS**   **L T P C**
3 0 0 3

OBJECTIVES:
- To study the characteristics and classification of biomaterials.
- To understand the response of biomaterials in living system.
- To learn about the polymeric materials and composites in tissue replacements.
- To know the compatibility and functioning of artificial organs inside the living system.

UNIT I   **STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY**   **9**
Definition and classification of bio-materials, mechanical properties, visco elasticity, wound-healing process, body response to implants, blood compatibility, HLA compatibility.

UNIT II   **IMPLANT MATERIALS**   **9**
Metallic implant materials, stainless steels, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications.

UNIT III   **POLYMERIC IMPLANT MATERIALS**   **9**
Polymerization, polyamides, Acryrilic polymers, Hydrogels, rubbers, high strength, thermoplastics, medical applications. Bio polymers: collagen and elastin. Medical Textiles: silica, chitosan, PLA, composites, Sutures, wound dressings. Materials for ophthalmology: contact lens, Intra ocular lens. Membranes for plasma separation and blood oxygenation.

UNIT IV   **TISSUE REPLACEMENT IMPLANTS**   **9**
Small intestinal submucosa and other decellularized matrix biomaterials for tissue repair. Soft-tissue replacements, types of transplant by stem cell, sutures, surgical tapes, Tissue adhesive/glue. Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, Pancreas replacement.

UNIT V   **ARTIFICIAL ORGANS**   **9**
Artificial Blood, Artificial Skin, Artificial Heart, Prosthetic Cardiac valves, Artificial Lung(Oxygenator), Artificial Kidney (Dialyzer Membrane), Dental Implants, Retinal Implants.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will able to
CO1: Analyze different types of materials and its application in biomedical field.
CO2: Choose materials for design of implants in tissue replacement.
CO3: Evaluate response of biomaterials in living system.
CO4: Assess compatibility and functioning of artificial organs inside the living system.
CO5: Design and develop biomaterial based scaffold for biomedical application.

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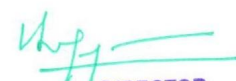Anna University, Chennai-600 025

TEXT BOOKS:
1. Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, 7th Edition, 2005.
2. JoonB.Park Joseph D. Bronzino, "Biomaterials - Principles and Applications", CRC press, 2003.

REFERENCES:
1. H.H.Willard,D.L.Merrit, "Instrumental Methods of Analysis",CBS Publishers, 1992.
2. ParkJ.B., "Biomaterials Science and Engineering", Plenum Press,1984.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill, 2003
4. John Enderle, Joseph D.Bronzino, Susan M.Blanchard, "Introduction to Biomedical Engineering", Elsevier, 2005.
5. AC Anand, JF Kennedy, M. Miraftab, S.Rajendran, "Medical Textiles and Biomaterials for Health Care", Woodhead Publishing Limited, 2006.
6. D F Williams, "Medical and Dental Materials: A comprehensive Treatment-Volume 14", VCH Publishers, 1992.
7. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, "An introduction to Materials in Medicine", Academic Press, 1996.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√				√	√	√	√	√	√
CO2		√	√	√			√	√	√	√	√	√
CO3		√					√	√	√	√	√	√
CO4		√					√	√	√	√	√	√
CO5		√	√	√			√	√	√	√	√	√

BM5007   **BIOMATERIALS AND CHARACTERISATION**   **L T P C**
                                                                 3 0 0 3

OBJECTIVES:
- To study the characteristic features of bio materials in medicine.
- To know biocompatibility and functionality of biomaterials and implement in living system.

UNIT I   BIOMATERIALS AND PROPERTIES   9
Introduction to biomaterials and requirements for biomaterial. Classification of biomaterials: metallic, ceramic, synthetic and natural polymers. Properties of biomaterials: bulk properties and surface properties, ethics.

UNIT II   PHYSIO-CHEMICAL CHARACTERIZATION   9
Material Characterization: X-ray Diffraction Analysis (XRD), FT- Raman and micro Raman analysis, electron spectroscopy for chemical Analysis (ESCA) and X-ray photo electron spectroscopy (XPS), mechanical testing: tensile, compression, wears, fatigue, corrosion studies and fracture toughness. Thermal and viscoelastic properties.

UNIT III   SURFACE CHARACTERIZATION   9
Surface properties and adhesion, contact angle measurement, scanning electron microscopy (SEM), transmission electron microcopy (TEM), scanning tunneling microscopy and atomic force microscopy (AFM).Secondary ion mass spectrometry and confocal laser scanning microscopy.

UNIT IV   BIOMATERIAL TESTING   9
Biofunctionality and biocompatibility, preservation techniques for biomaterials, in vitro & in vivo assessment of tissue compatibility, testing of blood (HLA typing and blood grouping) –materials, interactions and animal models.

UNIT V   BIOMATERIALS IN MEDICINE   9

Materials for bone and joint replacement - stainless steel, titanium based materials and porous metals. Ceramics: alumina, zirconia, calcium phosphate and bioactive glass, bone cement. Polymers: PMMA and polyethylene, rubber and fluorocarbon polymers. Materials for oral and maxillofacial surgery, ophthalmology and intelligent textiles for medical applications. (examples for each).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

 At the end of the course, the student will be able to

CO1: Apply the knowledge of science and engineering and to function on multidisciplinary team.
CO2: Analyze different types of materials and their properties.
CO3: Explain the basic principles and features of polymeric materials and understand key relationship between the structure, property and processing of polymers.
CO4: Analyze the roles of the natural and synthetic polymer in designing the medical device.
CO5: Explain methods to repair and regenerate injured or lost functional tissue with materials, autologous or stem cells.

TEXT BOOKS:

1. Sujata V. Bhatt, ―Biomaterials" Narosa Publishing House, 2nd Edition, 2005.
2. Joon B.Park Joseph D.Bronzino -Biomaterials – Principles and Applications– CRC Press, 2003.

REFERENCES:

1.   H.H.Willard, "Instrumental Methods of Analysis", CBS Publishers, 1992.
2.   Park J.B., "Biomaterials Science and Engineering", Plenum Press, 1984.
3.   Myer Kutz ,"Standard Handbook of Biomedical Engineering & Design", McGraw-Hill, 2003.
4.   John Enderle, Joseph D. Bronzino, Susan M. Blanchard, "Introduction to Biomedical Engineering'', Elsevier, 2005.
5.   AC ANAND, J F Kennedy, M. Miraftab, S. Rajendran, "Medical Textiles and Biomaterials for Healthcare", Woodhead Publishing Limited, 2006.
6.   D F Williams, "Medical and Dental Materials: A comprehensive Treatment'', VCH Publishers, 1992.
7.   BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, "An introduction to Materials in Medicine", Academic Press, 1996.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√				√	√	√	√	√	√
CO2		√	√	√	√		√	√	√	√	√	√
CO3			√				√	√	√	√	√	√
CO4			√		√		√	√	√	√	√	√
CO5		√	√	√	√		√	√	√	√	√	√

BM5008   **BIOMETRIC SYSTEMS**   **L T P C**
                                                                       3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To understand the general principles of design of biometric systems and the underlying trade-offs.
- To study the technologies of fingerprint, iris, face and speech recognition.
- To study of evaluation of biometrics systems.

UNIT I   INTRODUCTION TO BIOMETRICS   9
Introduction and back ground – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate- Derived metrics-Biometrics and Privacy.

UNIT II   FINGERPRINT TECHNOLOGY   9
History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT III   FACE RECOGNITION AND HAND GEOMETRY   9
Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images, Neural networks for face recognition, Hand geometry – scanning – Feature Extraction – classification.

UNIT IV   IRIS RECOGNITION   9
Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde's approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.

UNIT V   VOICE SCAN AND MULTIMODAL BIOMETRICS   9
Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy, examples of multimodal biometric systems, Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC).

                                                          TOTAL: 45PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Demonstrate the principles of biometric systems.
CO2: Develop fingerprint recognition technique.
CO3: Design face recognition and hand geometry system.
CO4: Design iris recognition system.
CO5: Develop speech recognition and multimodal biometric systems.

TEXT BOOKS:
1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 1st Edition, 2011.
2. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.

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REFERENCES:
1. Nalini K Ratha, Ruud Bolle, "Automatic fingerprint recognition system", Springer, 2003.
2. L C Jain, I Hayashi, S B Lee, U Halici, "Intelligent Biometric Techniques in Fingerprint and Face Recognition", CRC Press, 1st Edition, 1999.
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2004.
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley & Sons, 2003.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		√		√				√	√	√		√
CO2				√	√			√	√	√		√
CO3				√	√			√	√	√		√
CO4				√	√			√	√	√		√
CO5				√	√			√	√	√		√

BM5009   **BODY AREA NETWORKS**   **L T P C**
                                                                 3 0 0 3

OBJECTIVES:
- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

UNIT I   INTRODUCTION   9
Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT II   HARDWARE FOR BAN   9
Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III   WIRELESS COMMUNICATION AND NETWORK   9
RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV   COEXISTENCE ISSUES WITH BAN   9
Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V   APPLICATIONS OF BAN   9
Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

At the end of the course the student will be able to
CO1: Comprehend and appreciate the significance and role of this course in the present
      contemporary world.
CO2: Design a BAN for appropriate application in medicine.
CO3: Assess the efficiency of communication and the security parameters.
CO4: Understand the need for medical device regulation and regulations followed in various
      regions.
CO5: Extend the concepts of BAN for medical applications.

TEXT BOOKS:
1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area
   Networks Safety, Security, and Sustainability'', Cambridge University Press, 2013.

REFERENCES:
1. Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems'', Springer, 2013.
2. Guang-Zhong Yang(Ed.), "Body Sensor Networks'', Springer, 2006.
3. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation,
   and Applications", Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		√										√
CO2		√	√	√	√	√	√	√	√			√
CO3					√	√	√	√	√	√		√
CO4								√			√	√
CO5												√

BM5010   **BRAIN COMPUTER INTERFACE AND APPLICATIONS**   **L T P C**
                                                                          3 0 0 3
OBJECTIVES:
- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT I   INTRODUCTION TO BCI   9
Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive
and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT II   ELECTROPHYSIOLOGICAL SOURCES   9
Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300
- Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT III   FEATURE EXTRACTION METHODS   9
Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods –
AR,MA,ARMA models – PCA – Linear and Non-Linear Features.

UNIT IV   FEATURE TRANSLATION METHODS   9
Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization–
Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V   APPLICATIONS OF BCI   9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Describe BCI system and its potential applications.
CO2: Analyze event related potentials and sensory motor rhythms.
CO3: Compute features suitable for BCI.
CO4: Design classifier for a BCI system.
CO5: Implement BCI for various applications.

TEXT BOOKS:
1. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
2. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.

REFERENCES:
1. Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
2. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			√	√	√	√	√	√	√			√
CO2			√	√	√	√	√	√	√			√
CO3			√	√	√	√	√	√	√	√	√	√
CO4			√	√	√	√	√	√	√	√	√	√
CO5			√	√	√	√	√	√	√	√	√	√

BM5011   **PHYSIOLOGICAL MODELLING**   **L T P C**
                                                              3 0 0 3

OBJECTIVES:
- To understand the application of Physiological models and Vital organs.
- To understand methods and techniques for analysis and synthesis of dynamic models
- To model dynamically varying physiological system
- To develop differential equations to describe the dynamic models
- To simulate and visualize, dynamic responses of physiological models using software.

UNIT I   SYSTEM CONCEPT   9

Introduction to Physiological control systems, Purpose of physiological modeling and signal analysis, Illustration- example of a physiological control system. Difference between engineering and physiological control systems. System variables and properties- Resistance – both static and dynamic, Compliance and combination of resistance and compliance. Resistance and compliance models - respiratory system, aortic segments, lumped model of physiological thermal system, and step response of resistance-compliance system – dye dilution study of circulation

UNIT II   SYSTEM ANALYSIS   9

Review of transfer function, transfer function of coupled system. Impedance based transfer function - flexible tube feeding a single port compliant model, development of a lung model. Periodic signals: sinusoidal analysis of second order system, analysis of respiratory system based on sinusoidal excitation, pendelluft.

UNIT III   TRANSIENTAND FEEDBACK   9
Review of transient and stability analysis. Homeostasis, representation, finger tracking. Characterization of Physiological Feedback systems- Hypophysis adrenal systems. Nonlinear systems and linearization - transfer function analysis of pupillary control system as a closed loop and method of opening the closed loop, pupillary hippus.

UNIT IV   MODELING OF CARDIOPULMONARY SYSTEM   9
Model of cardiac output regulation - Starling's law, Physical Significance of under damped responses of post systolic operations in aortic arch, model of circadian rhythms, chemical regulation of ventilation, Cheyne-Stoke breathing, biot breathing.

UNIT V   OTHER PHYSIOLOGICAL MODELS AND SIMULATION   9
Steady state analysis of regulation of glucose, Hodgin-Huxley model, Thermal system – model and simulation, modeling of eye movement- types of eye movement, saccade model, model of occulomotor control. Introduction to digital control system.

TOTAL: 45PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to:
CO1: Explain application of Physiological models.
CO2: Model dynamically varying physiological system.
CO3: Analyze and synthesize dynamic models of physiological system.
CO4: Develop differential equations to describe the dynamic models, simulate and visualize.
CO5: Implement physiological models using software to get dynamic responses.

TEXT BOOKS :
 1. William B.Blesser, "A System Approach to Biomedicine", McGraw Hill Book Co., New York, 1969.
 2. Micheal C.K.Khoo ,"Physiological Control System Analysis, Simulation and Estimation", Prentice Hall of India , New Delhi ,2001.

REFERENCES:
1. Manfreo Clynes and John H.Milsum, "Biomedical Engineering System", McGraw Hilland Co., New York ,1970.
2. Richard Skalak and ShuChien, "Hand Book of Biomedical Engineering" , McGraw Hilland Co., New York, 1987.
3. Douglas S.Rigg, "Control Theory and Physiological Feedback Mechanism", The Wilkliam and Wilkins Co. Baltimore, 1970.
4. Joseph D,Bronzino, "The Biomedical Engineering Handbook", CRC Press,3rd Edition, 2006.
5. ChristofKoch, "Biophysics of Computation", Oxford University Press, 2004.
6. F.C. Hoppensteadt and C.S.Peskin, "Modeling and Simulation in Medicine and the Life Sciences" Springer, 2nd Edition, 2002.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					√	√	√	√	√			√
CO2					√	√	√	√	√			√
CO3			√	√	√	√	√	√	√	√		√
CO4					√	√	√	√	√			√
CO5					√	√	√	√	√	√		√

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BM5012   **MEDICAL OPTICS**   **L T P C**
                                                                             3 0 0 3

OBJECTIVES:
- Provide a possibility for the student to acquire knowledge about the impact and interaction of light with biological tissue.
- Understand practical applications of optics related to medicine.

UNIT I   INSTRUMENTATION IN PHOTONICS   9
Review of basic properties of light – Reflection, Refraction, Scattering, fluorescence and phosphorescence. Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers. Optical filters. Optical detectors - Time resolved and phase resolved detectors, optical tweezers.

UNIT II   OPTICAL PROPERTIES OF THE TISSUES   9
Light transport inside the tissue, optical properties of tissue. Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical, Thermal, Electromechanical. Photo ablative processes.

UNIT III   SURGICAL APPLICATIONS OF LASERS   9
Lasers in ophthalmology- Dermatology –Dentistry-Urology-Otolaryngology- Tissue welding.

UNIT IV   NON THERMAL DIAGNOSTIC APPLICATIONS   9
Optical coherence tomography, Elastography, Laser Induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and Imaging, FLIM – Holographic and speckle application of lasers in biology and medicine.

UNIT V   THERAPEUTIC APPLICATIONS   9
Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT - Biostimulation effect – applications-Laser Safety Procedures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Demonstrate knowledge of the fundamentals of optical properties of tissues.
CO3: Describe surgical applications of laser.
CO4: Describe photonics and its therapeutic applications.
CO5: Apply the concepts of laser and light to understand the laser safety procedures.

TEXT BOOKS:
1. Markolf H.Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. Paras N. Prasad, "Introduction to Bio photonics", A. John Wiley and sons, Inc. Publications, 2003.

REFERENCES:
1. Tuan Vo Dinh, "Biomedical photonics – Handbook", CRC Press LLC, 2003.
2. Mark E. Brezinski, "Optical Coherence Tomography: Principles and Applications", Academic Press, 2006.
3. R. Splinter and B.A. Hooper, "An Introduction to Biomedical Optics", Taylor and Francis, 2007.
4.Helena Jelinkova, "Lasers for Medical Applications: Diagnostics, Therapy and Surgery'', Woodhead Publishing, 1st Edition, 2013.

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COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√				√							√
CO2					√	√	√	√		√		√
CO3		√				√	√	√		√		√
CO4		√			√	√	√			√		√
CO5					√	√	√	√		√		√

BM5013   **MEDICAL PHYSICS**   **L T P C**
                                                                       3 0 0 3

OBJECTIVES:
- To study effects of sound and light in human body
- To understand the effects of radiation in matter and how isotopes are produced

UNIT I   NON IONIZING RADIATION AND ITS MEDICAL APPLICATION   9
Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Thermography – Application. Ultrasound Transducer - Interaction of Ultrasound with matter; Cavitations, Conditions for reflection, Transmission-Scanning systems – Artefacts- Ultrasound-Doppler-Double Doppler shift Clinical Applications.

UNIT II   PRINCIPLES OF RADIOACTIVE NUCLIDES   9
Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radio- nuclide-fission and electron Capture reaction, radionuclide Generator-Milking process (Technetiumgenerator).

UNIT III   INTERACTION OF RADIATION WITH MATTER   9
Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

UNIT IV   PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS   9
Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge, TLD, OSLD.

UNIT V   BASIC RADIATION QUANTITIES   9
Introduction -exposure- Inverse square law-KERMA-Kerma and absorbed dose -stopping power - relationship between the dosimetric quantities - Bremsstrahlung radiation, Bragg"s curve- concept of LD 50- Stochastic and Non-stochastic effects, Different radiation Unit, Roentgen, gray, Sievert.

TOTAL: 45 PERIODS.

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COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: Discuss the effect of non ionising radiation in human body and applications in the field of medicine.

CO3: Understand radioactive decay and production of radio nuclides.

CO4: Discuss the measurement of ionizing radiation.

CO5: Enumerate the effect of ionising radiation in human body.

TEXT BOOKS:

1. JohnR Cameron, James G Skofronick, "Medical Physics",John-Wiley&Sons,1978.
2. W.J.Meredith andJ.B. Massey, "Fundamental Physics of Radiology" Varghese Publishing house.1992.

REFERENCES:

1. P.Uma Devi, A.Nagarathnam, BS Satish Rao, "Introduction to Radiation Biology", B.I Chur Chill Livingstone Pvt. Ltd, 2000.
2. S.Webb, "The Physics of Medical Imaging", Taylor and Francis, 1988.
3. J.P.Woodcock, Ultrasonic, "Medical Physics Handbook series 1",Adam Hilger, Bristol, 2002.
4. Hylton B.Meire and Pat Farrant, "Basic Ultrasound", John Wiley & Sons, 1995.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√									√		√
CO2					√		√	√	√	√		√
CO3					√	√	√	√	√	√		√
CO4					√	√	√	√	√	√		√
CO5					√	√	√	√	√	√		√

PROGRESS THROUGH KNOWLEDGE

BM5014 **MEMS AND ITS BIOMEDICAL APPLICATIONS** **L T P C**
3 0 0 3

OBJECTIVES:

- To learn various MEMS fabrication techniques.
- To understand different types of sensors and actuators and their principles of operation at the micro scale level.
- To know the applications of MEMS in different fields of medicine

UNIT I MEMS MATERIALS AND FABRICATION 9

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 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, 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, PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic 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 9

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- electro wetting, thermocapillary effect, electro osmosis, dielectrophoresis. Microfluid dispenser, microneedle, micro pumps-continuous flow system, micromixers.

UNIT V APPLICATIONS OF BIOMEMS 9

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, electronic nose. Introduction to 3D printing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Discuss various MEMS fabrication techniques.
CO2: Explain different types of sensors and actuators and their principles of operation at the micro scale level.
CO3: Comprehend the characteristics of fluid flow and actuation through micro channels.
CO4: Explain the need and use of CAD for MEMS design.
CO5: Design MEMS devices for different medical applications.
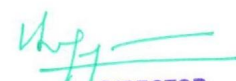
TEXT BOOKS:
1. Chang Liu, " Foundations of MEMS", Pearson Education International, New Jersey, USA, 2nd Edition, 2011.
2. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002

REFERENCES:
1. Wanjun Wang, Stephen A.Soper, "BioMEMS: Technologies and applications", CRC Press, New York, 2007
2. Marc J. Madou, "Fundamentals of Microfabrication: the science of miniaturization'', CRC Press, 2002.
3. Nadim Maluf, Kirt Williams, "An Introduction to Microelectro mechanical Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
4. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√									√
CO2	√	√	√									√
CO3		√				√	√	√	√	√		√
CO4		√		√	√							√
CO5			√	√	√	√	√	√	√	√	√	√

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REHABILITATION ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

- To explain the need for medical aids.
- To understand the sensory rehabilitation systems.
- To learn the use of the orthopedic prosthetics and orthotics in rehabilitation.
- To have an understanding of rehabilitation medicine and advocacy.

UNIT I INTRODUCTION 9
Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects. .

UNIT II ENGINEERING CONCEPTS IN SENSORY REHABILITATION ENGINEERING 9
Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system- Tactual augmentation, Tactual substitution, Computerized wheel chairs.

UNIT III ORTHOPEDIC PROSTHETICS AND ORTHOTICS IN REHABILITATION 9
Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT IV VIRTUAL REALITY IN REHABILITATION 9
Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9
Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to
CO1: Understand the key terminologies used by the rehabilitation team.
CO2: Devise new concepts for future development and applications.
CO3: Design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation applications.
CO4: Understand the need of virtual reality tools for different aids.
CO5: Appreciate the legal aspects for building rehabilitation aids for the needed people.

TEXT BOOKS:
1. Joseph D Bronzino, "The Biomedical Engineering Handbook". 2nd edition, CRC Press,2000.
2. Robinson C.J, "Rehabilitation Engineering", CRC Press , 2006.

REFERENCES:
1. Sashi S Kommu, "Rehabilitation Robotics", 1st edition, CRC Press, 2007.
2. Sunder, "Textbooks of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007.
3. Horia- Nocholai Teodorecu, L.C.Jain, "Intelligent systems and technologies in rehabilitation Engineering", CRC; December 2000.
4. Etienne Grandjean, Harold Oldroyd, "Fitting the task to the man", Taylor & Francis,1988.
5. Keswick. J., "what is Rehabilitation Engineering, Annual Reviews of Rehabilitation", Springer-Verlag, New York, 1982.
6. Warren E. Finn, Peter G. Lopressor, "Handbook of Neuroprosthetic Methods",CRC, 2002.
7. Rory A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering" CRC Press, 2006.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√	√		√	√	√				√
CO2			√	√	√	√	√	√	√		√	√
CO3			√	√	√	√	√	√	√	√	√	√
CO4					√	√		√		√		√
CO5					√	√	√					√

BM5016 **VIRTUAL REALITY IN MEDICINE** **L T P C**
3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To impart the fundamental aspects, principles of virtual reality technology.
- To gain knowledge about applications of virtual reality.

UNIT I **INTRODUCTION** **10**
The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - **Input Devices :**(Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-**Output Devices:** Graphics displays-sound displays & haptic feedback.

UNIT II **MODELING** **9**
Geometric modeling - kinematics modeling- physical modeling - behavior modeling - model management.

UNIT III **HUMAN FACTORS** **8**
Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT IV **VR PROGRAMMING** **10**
Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites- animated 3D sprites-particle systems.

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UNIT V **APPLICATIONS** **8**
Medical applications--robotics applications- Advanced Real time Tracking-other applications-games, movies, simulations, therapy

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to
CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Understand the basic concepts of Virtual reality.
CO3: Expose the concept of Virtual Reality Programming with toolkits.
CO4: Design of various modeling concepts.
CO5: Develop the Virtual Reality applications in different areas.

TEXT BOOKS:
1. C. Burdea& Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Andrew Davison, "Killer Game Programming in Java", Oreilly SPD, 2005.

REFERENCES:
1. John Vince, "Introduction to Virtual Reality", Springer-Verlag Ltd., 2004.
2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality – Interface, Application, Design", The Morgan Kaufmann Series, 2003.

BM5017	WEARABLE SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To know the sensor and signal processing requirement of wearable systems
- To understand the communication and security aspects
- To know the level of energy involvement in wearable systems

UNIT I   SENSORS   9
Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS –Based Biosensors, E-Textiles, Bio compatibility

UNIT II   SIGNAL PROCESSING   9
Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Datamining.

UNIT III   ENERGY HARVESTING FOR WEARABLE DEVICES   9
Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT IV   WIRELESS HEALTH SYSTEMS   9
Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.

UNIT V   APPLICATIONS OF WEARABLE SYSTEMS   9
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics

TOTAL: 45 PERIODS

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COURSE OUTCOMES:
At the end of the course student will be able to
CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world
CO2: Choose appropriate sensors and signal processing techniques for wearable systems
CO3: Assess the energy requirement for a wearable system and analyse and experiment energy harvesting techniques for wearable systems
CO4: Appreciate the need for BAN and the challenges involved in the design of BAN
CO5: Design basic wearable systems for medical applications

TEXT BOOKS:
1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer,2011.
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata subramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press,2013.

REFERENCES:
1. Hang,Yuan-Ting, "Wearable medical sensors andsystems",Springer-2013.
2. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt. Ltd, Singapore,2012.
3. Guang-Zhong Yang(Ed.), "Body Sensor Networks, "Springer,2006.
4. Andreas Lymberis, Danilo de Rossi ,'Wearable eHealth systems for Personalized Health Management - State of the art and future challenges ' IOS press, The Netherlands,2004.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		√										√
CO2		√	√	√	√	√	√	√				√
CO3					√	√	√	√	√	√		√
CO4					√	√	√	√	√		√	√
CO5					√	√	√	√	√	√	√	√

BM5018   **NEURAL ENGINEERING**   **L T P C**
                                                                         3 0 0 3

OBJECTIVES:
- To be familiar with the nervous system development
- To be exposed to neuronal diseases and disorders
- To be familiar with nerve reconstruction and repairing

UNIT I   BASICS OF NEURON STRUCTURE AND FUNCTIONS   9
Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure – function – classification. Glial cells – myelination. Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons.

UNIT II   BRAIN, BRAIN STEM AND SPINAL CORD   9
Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Blood supply to Brain and spinal cord.

Attested

UNIT III   NEURONAL DISEASES AND DISORDERS   9
Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration.Neuronal plasticity – CNS acting drugs and their pharmacokinetics. Alzheimer's, Parkinson's and Prion diseases.

UNIT IV NEUROPHYSIOLOGY & NEURORADIOLOGY 9

Physiology of nerve conduction. Peripheral nerves – structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system. . Neuromotor-machine interface: human voluntary motor control system.

UNIT V NERVE RECONSTRUCTION AND REHABILITATION 9

Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to

CO1: Explain the basic structure and functions of human nervous system.
CO2: Understand diseases and degeneration related to nervous system.
CO3: Analyze visualization and radiological assessment of nervous system.
CO4: Apply neural tissue engineering for rehabilitation.
CO5: Discuss about Regeneration of nervous system.

TEXT BOOKS:
1. Mathews G.G., "Neurobiology", 2nd edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter, "Textbooks of Neuroanatomy", Mc. Graw hill Edition, 1996.

REFERENCES:
1. W. Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement organs and tissue'', Oxford University Press Inc New York, 2004.
2. Park J.B., "ACS Biomaterials Science and Engineering", Plenum Press, 2014. Saunders, 2006.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2	√	√										√
CO3			√	√	√							√
CO4			√	√	√	√	√	√			√	√
CO5			√	√	√	√	√	√	√		√	√

BM5019 ADVANCED BIO ANALYTICAL AND THERAPEUTIC TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:
- To understand the basic preparation of standards.
- To study common analytical techniques.
- To enumerate the effects of radioactive radiation on human body.
- To learn the appropriate technique for a given size & type of sample.
- To understand the scientific foundation concerning characterization, testing and approval of nanoscale drugs in diagnostics, imaging agents, and therapeutics

UNIT I ANALYTICAL TECHNIQUES 9

Principle, instrumentation and application of electrophoresis- SDS, native gel. UV and IR spectroscopy and its application. Spectrophotometry, fluorimetry. NMR – principle, instrumentation and application in medical sciences.

UNIT II   ENZYMES AS A DIAGNOSTIC TOOL   9
Isoenzymes and their screening techniques, enzyme pattern in health and diseased condition: lipase, amylase, ALP, ACP, SGOT, SGPT, LDH & CPK. Biosensors- enzyme based, antibody based, DNA based and optical biosensor. Blotting techniques. Automation in clinical laboratory.

UNIT III   RADIOISOTOPIC TECHNIQUES   9
Types of radioisotopes, units of measurements, methods in measuring radioactivity –G.M liquid scintillation counter application in diagnosis (RIA & ELISA) , autoradiography, biological hazards, safety measures in handling isotopes, disposal of labeled compounds and dosimetry.

UNIT IV   GENE THERAPY   9
Human genome project, central concept of gene therapy, prerequisite of human gene therapy, biological basis of gene therapy strategies, vehicles for gene transfer, gene transfer methods, clinical gene therapy case studies for hereditary disease, cancer and HIV. Ethical issues in human gene therapy.

UNIT V   NANOTHERAPEUTICS   9
Introduction to nanoparticles – their types, nanocarriers in drug delivery, synthesis and physiochemical properties of particles at nanoscale. Transport across biological barriers, Nanotechnology in Cancer therapy, bone treatment, oral vaccination and skin disease. Fate of nanoparticle and its toxicity.

TOTAL: 45PERIODS

COURSE OUTCOMES:
 At the end of course, the student will be able to
CO1: Report and discuss on chemical analytical aspects relevant for the selection of proper analytical techniques.
CO2: Implement bio analytical aspects in medical sciences.
CO3: Discuss on preventive measures of radioactive pollution and regulations regarding safety measures for radiation exposure.
CO4: Analyze the underlying etiology of the disease that might be treated by gene therapy.
CO5: Describe the basic science behind the properties of materials at nanoscale and the principles behind advanced experimental and computational techniques for studying nanomaterials.

TEXT BOOKS:
1. Douglas A, "Principles of Instrumental Analysis", Skoog Brooks Cole publisher, 6th Edition 2006.
2. Keith Wilson & John Walker, "Practical Biochemistry – Principles and Techniques", Oxford University Press, 7th Edition, 2010.

REFERENCES:
1. Trevor Palmer, "Understanding Enzymes", Published by Ellis Horwood LTD, 4th Edition, 1995.
2. Harvey Lodish W. H, "Molecular Cell Biology", Freeman publisher 7th Edition, 2012.
3. G. Louis Hornyak, John J. Moore, Harry F. Tibbals and Joydeep Dutta, "Fundamentals of Nanotechnology", CRC press, 1st Edition, 2008.
4. Gabor L. Hornyak, Joydeep Dutta, H.F. Tibbals, Anil Rao, "Introduction to NanoScience", CRC Press, 2008.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√									√
CO2				√	√	√	√	√			√	√
CO3				√	√	√	√					√
CO4				√	√	√	√	√				√
CO5				√	√	√	√	√			√	√

PRINCIPLES OF TISSUE ENGINEERING   **L T P C**
                                                                              3 0 0 3

OBJECTIVES:
- To study Cell cycle and differentiation
- To learn basics about stem cells and its applications
- To describe different synthetic and natural biomaterials in tissue replacements

UNIT I   FUNDAMENTALS OF TISSUE ENGINEERING   9
Tissue Engineering: Introduction - Objectives of tissue engineering - Laboratory set up for tissue engineering. Tissue development and Tissue exchange - Cell cycle and differentiation - cell adhesion - cell adhesion molecules - cell migration - cell aggregation and tissue equivalent.

UNIT II   COMPONENTS OF TISSUE ENGINEERING   9
Cell: Cell harvesting In Vitro – Medium: Synthetic and Biological media – Scaffold: Natural and Synthetic scaffold: Cell and Drug delivery systems - Transplantation – Implantation - Nanotechnology in tissue engineering – Biocompatibility studies In Vitro and In Vivo.

UNIT III   STEM CELLS   8
Definition of stem cells – types of stem cells – differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization. Sources of stem cells: haematopoetic – fetal - cord blood – placenta - bone marrow - primordial germ cells - cancer stem cells - induced pleuripotent stem cells.

UNIT IV   MATERIALS IN TISSUE ENGINEERING   9
Biological materials – degradable and non degradable – extra cellular matrix-decellularization - Polymers: synthetic and natural – cell interaction with polymers – applications of polymer. Ceramics and Metals.

UNIT V   APPLICATION OF TISSUE ENGINEERING   10
Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver. Regenerative engineering: peripheral Nerve regeneration – cardiac tissue regeneration – muscle regeneration – Tissue Engineered Food. Regulation, Commercialization and Patenting.

                                                                    TOTAL : 45 PERIODS
COURSE OUTCOMES:
After the completion of these course students will be able to
CO1: Understand the basic concepts of tissue engineering
CO2: Acquire ability to function on multi-disciplinary teams
CO3: Apply the knowledge of professional and ethical responsibility in use of stem cells and gene
         therapy in creating tissue engineered therapies.
CO4: Design and develop different biomaterial in tissue engineering application.
CO5: Gain knowledge in research or clinical application on tissue repair/ engineering.

TEXT BOOKS:
1. W. Mark Saltzman, "Tissue Engineering – Engineering principles for design of replacement organs and tissue",Oxford University Press Inc New York, 2004.
2. CS Potten, "Stem cells", Elsevier, 1996.

REFERENCES:
1. Gary E. Wnek, Gary L Browlin , "Encyclopedia of Biomaterials and Biomedical Engineering",Marcel Dekker Inc, New York, 2008.
2. R. Lanza, Anthony Atala (Eds), "Essential of Stem Cell Biology", Academic Press, USA, 2013.
3. R. Lanza, Anthony Atala," Handbook of Stem Cells'', Academic Press, USA, 2012.

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COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√							√
CO2	√	√	√						√	√	√	
CO3						√	√	√				√
CO4			√	√	√	√	√	√			√	√
CO5			√	√	√	√	√	√			√	√

BM5021   **COMPUTER HARDWARE AND INTERFACING**   **L T P C**
                                                                                    3 0 0 3

OBJECTIVES:
- To Introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- The student should be made to learn advanced 8086 family of processors, mother boards, PC based data acquisition and troubleshooting of PCs.

UNIT I   PC HARDWARE AND OVERVIEW   9
System Unit - Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply - BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board logics - Memory and I/O map.

UNIT II   PROCESSORS ANDPERIPHERAL INTERFACING   9
Introduction to intel processors Intel CoreTM@ i7 Processor Keyboard and Mouse Interfaces - Memory types - RAM - SDRAM and RDRAM, Cache memory, ROM and its types, Flash memory, CMOS semiconductor memory - Adapter Cards - Sound Card, Modem card, Video card, Network Card.

UNIT III   PERIPHERAL CONTROLLERS   9
I/O slots - ISA, PCI and AGP bus slots - Ports - Serial and Parallel ports, USB, FireWire port, MIDI, SCSI, IrDA, Bluetooth – Connectors - System Bus, ISA, EISA, PCI, AGP and PCI bus - Disk controllers.

UNIT IV   TROUBLESHOOTING, MAINTAINING & REPAIRING   9
Memory troubleshooting, Monitor troubleshooting, Motherboard troubleshooting,Port troubleshooting, Sound Boards and Video adapters troubleshooting, USB troubleshooting.

UNIT V   COMPUTERISED DATA ACQUISITION AND PROGRAMMING   9
Plug-in-Data acquisition and control Boards, - Data acquisition using GPIB and serial Interfaces and Programming in C – DSP in Medical applications.

                                                                      TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Explain the concept of 8086 family of processors.
CO2: Understand motherboards concepts.
CO3: Able to troubleshoot the PCs.
CO4: Understand the concepts of peripheral controllers.
CO5: Known PC based data acquisition.

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TEXT BOOKS:
1. B. Govindarajalu, "IBM PC and clones Hardware, Trouble Shooting and Maintanance", Second Edition, Tata McGraw Hill, New Delhi, 2005.
2. N.Mathivanan, "PC –Based Instrumentation Concepts and Practice", Prentice Hall of India, New Delhi, 2007.

REFERENCES:
1. Douglus V.Hall, "Microprocessors and Interfacing, Programming and Hardware". Revised second Edition, Indian Edition. Tata McGraw Hill, New Delhi, 2007.
2. A.K.Ray, K.M. Bhurchandi, "Advanced microprocessors and peripherals", 2nd Edition, Tata Mc Graw Hill 2006.
3. Stephen J. Bigelow, "Troubleshooting, Maintaining & Repairing", Tata Mc Graw Hill Edition, 5th Edition.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√			√					√		√
CO2	√	√			√					√		√
CO3	√	√							√			√
CO4	√	√										√
CO5	√	√	√		√			√				√

EC5071   **ADVANCED MICROCONTROLLERS**   **L T P C**
                                                                               3 0 0 3
OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce the concept of microcontroller based system development.
- To introduce the concept of RISC and CISC microcontrollers.
- To study the architecture of PIC, R8C and MSP430 family microcontrollers

UNIT I   RISC PROCESSORS   9
RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC18xx microcontroller family, Architecture, Instruction set, ROM, RAM, Timer programming, Serial port programming, Interrupt programming, ADC and DAC interfacing, CCP module and programming.

UNIT II   CISC PROCESSORS   9
RL78 16 BIT Microcontroller architecture, addressing modes, on-Chip memory, ADC, interrupts, MAC unit, Barrel shifter, internal and external clock generation, memory CRC, on chip debug function and self programming.

UNIT III   MSP430 16 - BIT MICROCONTROLLER   9
The MSP430 Architecture, CPU Registers, Instruction Set, addressing modes, the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x. Low power aspects of MSP430 : low power modes, active Vs standby current consumption, FRAM Vs Flash for low power and reliability.

UNIT IV   PROGRAMMING AND PERIPHERAL INTERFACE USING MSP430 FAMILIES   9
Memory mapped peripherals, I/O pin multiplexing, Timers, RTC, watchdog timer, PWM control, Analog interfacing and data acquisition, DMA, programming with above internal peripherals using optimal power consumption. Case study: Remote control of air conditioner and home appliances.

UNIT V   COMMUNICATION INTERFACE USING MSP 430 MICROCONTROLLER   9

Serial and parallel communication, synchronous and asynchronous interfaces , Implementing and programming of : UART, I2C and SPI protocol. wireless connectivity : NFC, Zigbee, bluetooth and WiFi. MSP430 development tools. Case study: Implementing WiFi connectivity in smart electric meter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to discriminate RISC and CISC processors, and work with PIC microcontrollers.

CO2: Ability to work with the 16 bit microcontroller RL78 and design microcontroller based systems for a Real world application.

CO3: Gaining design knowledge and concepts on MSP430 family of Microcontroller.

CO4: Ability to design real time systems by deploy the Interfacing peripherals.

CO5: Ability to design and develop microcontroller based smart electronic system and home appliances.

TEXT BOOK:

1. Alaxander G, James M. Conard, " Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller", micrium press, USA, reprinted by S.P Printers, Haryana, 2011.

REFERENCES:

1. Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. "PIC Microcontroller and Embedded Systems", Pearson Education, 2008.
2. John H. Davies, "MSP 430 Micro controller basics", Elsevier, 2008.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2									1	
CO2											1	
CO3					2						1	
CO4		3	3		2						1	3
CO5		3	3	3	2	2					1	3

EC5072   **CRYPTOGRAPHY AND NETWORK SECURITY**   **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To teach the importance of security for networks
- To teach the basics of number theory and Galois field concepts
- To teach symmetric and asymmetric key in crypto systems
- To teach authentication and key management techniques
- To teach security specific to network layer

UNIT I   NUMBER THEORETIC AND ALGEBRAIC ALGORITHMS   9

Significance of network and data security   in todays communication scenario – Overall Classification - Integer Arithmetic Modular   Arithmetic – matrices – Linear   congruence- Substitution ciphers – Transposition ciphers – Stream cipher- Block ciphers – Algebraic structures – $GF(2^n)$ fields.

UNIT II   MODERN SYMMETRIC KEY CIPHERS   9

Modern block ciphers – Modern stream ciphers – DES – AES – uses of modern block ciphers and stream cipher, Application Examples

UNIT III   ASYMMETRIC KEY ENCIPHERMENT   9

Mathematics of cryptography – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic – Exponentiation & Logarithm – RSA, Rabin – Elliptic curve, Application Examples

UNIT IV   INTEGRITY AUTHENTICATION AND KEY MANAGEMENT   9

Message integrity – random oracle model – message authentication – SHA-512 – WHIRL POOL-Digital signature schemes Entity anthentication– password – challenge response – zero knowledge – Biometrics – Kerberos – symmetric key management – public key distribution – steganography, Application Examples.

UNIT V   NETWORK SECURITY   9

Security at the Application Layer: E-mail – PGP – S/MIME – Security at the transport layer: SSL and TLS – Security at the network layer: IPsec, Two Security Protocol – Security Association – Internet Key Exchange – ISAKMP, Application Examples.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: The student would have gained the knowledge about the importance of security for networks, use of number theory and Galois field concepts.

CO3: The student would have ability to design new symmetric and Asymmetric key crypto system

CO4: The student would have ability to develop new authentication and key management techniques

CO5: The student would have ability to develop a new network security protocols

TEXT BOOKS:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", 5th Edition, Tata McGraw Hill,.
2. W.Stallings, "Cryptography & Network Security: Principles and Practice", Prentice Hall, 4th Edition, 2003.

REFERENCES:

1. Douglas R.Stlinson, "Cryptography Theory and Practice", CRC Press series on Discrete Mathematics and its application 1995.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security Private Communication in a Public World", Pearson Education, 2nd Edition, 2003.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		2		2			1	1			
CO2	2	3		2		3		2				
CO3		2	3				3	3				
CO4	3	3	2		3	2			3		3	
CO5	1	3	3	3			2	1		2	1	

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EC5073   ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY   L T P C
3 0 0 3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques

UNIT I   BASIC CONCEPTS   7
Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

UNIT II   COUPLING MECHANISM   9
Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

UNIT III   EMI MITIGATION TECHNIQUES   10
Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

UNIT IV   STANDARDS AND REGULATION   7
Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

UNIT V   TEST METHODS AND INSTRUMENTATION   12
EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Ability to comprehend and appreciate the significance and role of this course in the present contemporary world Upon Completion of the course, the students will be able to:
CO1: To design a EMI free system.
CO2: To reduce system level crosstalk.
CO3: To design high speed Printed Circuit board with minimum interference.
CO4: To make our world free from unwanted electromagnetic environment

TEXT BOOKS:
1. V.P. Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press,New york, 2nd Edition, 2010
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 2009.

REFERENCES:
1. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech house, Norwood, 1987
3. C.R. Paul, "Introduction to Electromagnetic Compatibility", John wiley& sons Inc. 2006.

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EC5074   **FOUNDATIONS FOR NANO ELECTRONICS**   **L T P C**
                                                                  3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- The objectives of the course is to introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

UNIT I   INTRODUCTION TO QUANTUM MECHANICS   9
Particles, waves, probability amplitudes, schrodinger equation, wave packets solutions, operators, expectation values, eigenfuntions, piecewise constant potentials.

UNIT II   SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS   9
SHM Operators, SHM wavepacket solutions, Quantum LC circuit, WKB approximations, variational methods.

UNIT III   SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM   9
Two level systems with static and dynamic coupling, problems in more than one dimensions, electromagnetic field quantization, density of states.

UNIT IV   STATISTICAL MECHANICS   9
Basic concepts, microscopic, quantum systems in equilibrium, statistical models applied to metals and semiconductors

UNIT V   APPLICATIONS   9
Hydrogen and Helium atoms, electronic states, Atomic force microscope, Nuclear Magnetic Resonance, carbon nanotube properties and applications

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2: The student would have gained the knowledge on quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems

TEXT BOOKS:
1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction to Applied Quantum and Statistical Physics",, New York, NY: Wiley, 2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley, 3rd Edition, 2012.
3. Michael A. Nielsen and Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2000.

REFERENCES:
1. Neil Gershenfeld, "The Physics of Information Technology", Cambridge University Press, 2000.
2. Adrian Ionesu and Kaustav Banerjee eds. "Emerging Nanoelectronsu Life with and after CMOS", , Vol I, II, and III, Kluwer Academic, 2005.

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MULTIMEDIA COMPRESSION AND NETWORKS **L T P C**
3 0 0 3

OBJECTIVES:
- To introduce probability related study of the characteristics of text, voice, image and video data
- To introduce various compression schemes for text, voice, image and video • To analyse the compression schemes
- To introduce communication protocols for voice over internet and multimedia networking

UNIT I   MULTIMEDIA COMPONENTS   9
Introduction- Multimedia skills- Multimedia components and their characteristics- Text, sound, images, graphics, animation, video, hardware.

UNIT II   AUDIO AND VIDEO COMPRESSION   9
Audio compression–DPCM-Adaptive DPCM –adaptive predictive coding-linear Predictive coding code excited LPC-perpetual coding –Video compression principles-H.261, H.263, MPEG 1, 2, 4.

UNIT III   TEXT AND IMAGE COMPRESSION   9
Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy encoding –source encoding- text compression –static Huffman coding dynamic Huffman coding –arithmetic coding –Lempel Ziv-Welsh Compression-image compression

UNIT IV   VoIP TECHNOLOGY   9
Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service – CODEC Methods-VOIP applicability.

UNIT V   MULTIMEDIA NETWORKING   9
Multimedia Networking- Applications-Streamed stored and audio-making – Best Effort service protocols for real time interactive Applications-distributing multimedia-beyond best effort service secluding and Policing Mechanisms-Integrated services-Differentiated Services-RSVP.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to characterize the features of multimedia components.
CO2: Ability to develop audio and video processing systems.
CO3: Ability to develop compression algorithms for processing text and images.
CO4: Ability to tackle network issues in the transmission of text, audio and video signals.

TEXT BOOKS:
1. Fred Halshall, "Multimedia Communication - Applications, Networks, Protocols and Standards", Pearson education, 2007.
2. Tay Vaughan, "Multideai: Making It Work", TMH, 8th Edition, 2007.

REFERENCES:
1. Kurose and W. Ross, "Computer Networking A Top Down Approach", Pearson education, 3rd Edition, 2005.
2. Marcus Goncalves —Voice over IP Networks, McGraw Hill,

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3. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education, 2007
4. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 1st Edition, 1995.
5. Ranjan Parekh, "Principles of Multimedia", TMH, 2006.

EC5077   **REAL TIME EMBEDDED SYSTEMS**   **L T P C**
                                                                                  3 0 0 3

OBJECTIVES:
*   To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
*   To study the architecture and programming of ARM processors.
*   To introduce the basic concepts of hard real time multiprocessing.
*   To introduce the analytical concepts for effective programming.

UNIT I   INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS   9
Complex systems and microprocessors – Embedded system design process – Formalism for system design– Design example: Model train controller- ARM Processor Fundamentals- Instruction Set and Programming using ARM Processor

UNIT II   COMPUTING PLATFORM   9
CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption- CPU buses – Memory devices – I/O devices – Component interfacing- System Level Performance Analysis- Parallelism. Design Example: Data Compressor.

UNIT III   PROGRAM DESIGN AND ANALYSIS   9
Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Program Optimization- Analysis and optimization of execution time, power, energy, program size – Program validation and testing- Example: Software Modem.

UNIT IV   PROCESS AND OPERATING SYSTEMS   9
Multiple tasks and Multi processes – Processes – Context Switching – Operating Systems – Priority based Scheduling- RMS and EDF - Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

UNIT V   HARDWARE ACCELERATORS & NETWORKS   9
Multiprocessors- CPUs and Accelerators – Performance Analysis- Distributed Embedded Architecture – Networks for Embedded Systems: - I2C, CAN Bus, Ethernet, Myrinet – Network based design – Internet enabled systems. Design Example: Elevator Controller.

                                                            TOTAL : 45 PERIODS

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COURSE OUTCOMES:
- Ability to design and develop ARM processor based systems.
- Ability to comprehend and appreciate the significance and role of microcontrollers in embedded systems.
- Ability to analyze and demonstrate program design and optimization and proper scheduling of the process.
- Ability to apply the concept of process, multiprocesses and operating systems in embedded system design.
- Ability to implement various communication protocols in distributed embedded computing platform .

TEXT BOOKS:
1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), 3rd Edition, 2008.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide-Designing and Optimizing System Software", Elsevier/Morgan Kaufmann Publisher, 2008.

REFERENCES:
1. David E-Simon, "An Embedded Software Prime", Pearson Education, 2010.
2. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dreamtech press, 2005.
3. Jane. W. S. Liu, "Real-Time Systems", Pearson Education Asia, 2011.
4. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill, 2004.
5. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		1	2						2
CO2			3	2	1							
CO3		3	3	3	1							
CO4			3	1								
CO5	1	3	3	2		1						2

EC5078   **ROBOTICS**   **L T P C**
          3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce the electronics and software aspects in the design of robots
- To bring out the different languages for programming robot
- To specify robot requirements in the industry
- To introduce latest state of the art robots

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UNIT I   SCOPE OF ROBOTS   9
The scope of industrial Robots - Definition of an industrial robot - Need for industrial robots – Economic and Social Issues- applications.

UNIT II   ROBOT COMPONENTS   9
Fundamentals of Robot Technology - Automation and Robotics - Robot anatomy - Work volume - Precision of movement - End effectors - Sensors.

UNIT III   ROBOT PROGRAMMING   9
Robot Programming - Methods - interlocks textual languages. Characteristics of Robot level languages, characteristic of task level languages.

UNIT IV   ROBOT WORK CELL   9
Robot Cell Design and Control - Remote Center compliance - Safety in Robotics.

UNIT V   FUTURE TRENDS 14   9
Telepresence robot, Autonomous mobile robots, Walker Robots, Solar-ball Robot, Underwater bots, Aerobots, Advanced robotics in Space - Specific features of space robotics systems - long-term technical developments, Next generation robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2: Ability to design and develop robotic based systems.
CO3: Ability to develop system for industrial automation and medical applications.
CO4: Ability to provide automatic solution for replacing humans in life threatening area.

TEXT BOOKS:
1. Barry Leatham - Jones, "Elements of industrial Robotics", Pitman Publishing, 1987.
2. J. M. Selig, "Introductory Robotics", Prentice Hall, 1992.
3. John Iovine, "Robots, Android and Animatronics", McGraw-Hill, 2nd Edition, 2012.
4. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an Intelligent Machine", Newnes Publication, 2004.
5. Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.

REFERENCES:
1. MikellP.Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, "Industrial Robotics Technology, Programming and Applications", McGraw Hill Book Company 1986.
2. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence", McGraw Hill, International Editions, 1987.
3. Bernard Hodges and Paul Hallam, "Industrial Robotics", British Library Cataloging in Publication 1990.
4. Deb, S.R. , "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994.

EC5079 **SOFT COMPUTING AND APPLICATIONS** **L T P C**
3 0 0 3

OBJECTIVES:
- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- This course gives an idea and principles of various soft computing techniques, which are applicable to core areas such as networks , pattern recognition, image processing
- To introduce fuzzy set theory
- To teach different optimization techniques
- To introduce neural networks and neuro-fuzzy modeling
- To teach various applications of computational intelligence

UNIT I   **FUZZY SET THEORY**   **10**
Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II   **OPTIMIZATION**   **8**
Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms– Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III   **NEURAL NETWORKS**   **10**
Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation MutilayerPerceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV   **NEURO FUZZY MODELING**   **9**
Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling– Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT V   **APPLICATIONS OF COMPUTATIONAL INTELLIGENCE**   **8**
Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
Upon completion of the course, the student should be able to:
CO1: Apply various soft computing frame works.
CO2: Design of various neural networks.
CO3: Use fuzzy logic.

CO4: Discuss hybrid soft computing

TEXT BOOKS:
1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2006.

REFERENCES:
1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989.
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
4. R.Eberhart, P. Simpson and R. Dobbins, "Computational Intelligence - PC Tools", AP, Professional, Boston, 1996.
5. Dr.S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India, 2007.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√										√
CO2		√	√		√							√
CO3		√	√		√							√
CO4	√	√			√							√
CO5			√	√	√	√	√	√	√	√	√	√

EC5080   **SPEECH PROCESSING**   **L T P C**
                                                                                         3 0 0 3

OBJECTIVES:
- To introduce speech production and related parameters of speech
- To show the computation and use of techniques such as short time Fourier transform, linear predictive coefficients and other coefficients in the analysis of speech
- To understand different speech modeling procedures such as Markov and their implementation issues
- To introduce speech recognition and synthesis techniques

UNIT I   BASIC CONCEPTS   10
Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT II   SPEECH ANALYSIS   10
Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped

Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT III   SPEECH MODELING   8
 Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT IV   SPEECH RECOGNITION   8
Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent subword units; Applications and present status.

UNIT V   SPEECH SYNTHESIS   9
Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to use speech related parameters.
CO2: Ability to extract significant features from speech to reduce redundancy in speech by using several distortion measures.
CO3: Ability to develop models for speech signals.
CO4: Ability to develop speech recognition algorithms.
CO5: Ability to develop artificial speech generation of human speech.

TEXT BOOKS:
1.Lawrence Rabinerand Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processsing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 3rd Edition, 2018.

REFERENCES:
1. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, Reprint 2001
2. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing, 1997.
3. Thomas F Quatieri, "Discrete-Time Speech Signal Processing Principles and Practice", Pearson Education, 2004.
4. Claudio Becchetti and LucioPrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.
5. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing and Perception of Speech and Music", Wiley- India Edition, 2006 Edition.

EC5028   COMPUTER ARCHITECTURE AND ORGANIZATION   L T P C
3 0 0 3

OBJECTIVES:
* To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist,

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national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the general purpose architecture for computer system.
- To study the design of data path unit and control unit for ALU operation.
- Understanding the concept of various memories.
- To introduce the concept of interfacing and organization of multiple processors.

UNITI   INTRODUCTION   9
Computing and Computers, Evolution of Computers, VLSI Era, System Design- Register Level, Processor Level, CPU Organization, Data Representation, Fixed – Point Numbers, Floating Point Numbers, Instruction Formats, Instruction Types. Addressing modes.

UNIT II   DATA PATH DESIGN   9
Fixed Point Arithmetic, Addition, Subtraction, Multiplication and Division, Combinational and Sequential ALUs, Carry look ahead adder, Robertson algorithm, booth's algorithm, non-restoring division algorithm, Floating Point Arithmetic, Coprocessor, Pipeline Processing, Pipeline Design, Modified booth's Algorithm.

UNIT III   CONTROL DESIGN   9
Hardwired Control, Micro programmed Control, Multiplier Control Unit, CPU Control Unit, Pipeline Control, Instruction Pipelines, Pipeline Performance, Superscalar Processing, Nano Programming.

UNIT IV   MEMORY ORGANIZATION   9
Random Access Memories, Serial - Access Memories, RAM Interfaces, Magnetic Surface Recording, Optical Memories, multilevel memories, Cache & Virtual Memory, Memory Allocation, Associative Memory.

UNIT V   SYSTEM ORGANIZATION   9
Communication methods, Buses, Bus Control, Bus Interfacing, Bus arbitration, IO and system control, IO interface circuits, Handshaking, DMA and interrupts, vectored interrupts, PCI interrupts, pipeline interrupts, IOP organization, operation systems, multiprocessors, fault tolerance, RISC and CISC processors, Superscalar and vector processor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2: Describe data representation, instruction formats and the operation of a digital computer. (Level – II (Comprehension))
CO3: Illustrate the data path unit and control unit for ALU operation. (Level – I(Comprehension))
CO4: Discuss about implementation schemes of control unit and pipeline performance. (Level – II (Comprehension))
CO5: Explain the concept of various memories, interfacing and organization of multiple processors. (Level – II (Comprehension))
CO6: Discuss about the interrupts, I/Os and other components of the system. (Level – II (Comprehension))

TEXTBOOKS:
1. John P.Hayes,, "Computer architecture and Organization", Tata McGraw-Hill, 3rd Edition, 1998.

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2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", 5th Edition, McGraw-Hill Inc, 1996.

REFERENCES:
1. Morris Mano, "Computer System Architecture", Prentice-Hall ofIndia,2000.
2. Behrooz Paraami, "Computer Architecture, From Microprocessor to Supercomputers", Oxford University Press, Sixth impression, 2010.
3. P.PalChaudhuri, "Computer organization and design", Prentice Hall of India, 2nd Edition, 2007.
4. Miles J. Murdocca and Vincent P. Heuring, "Principles of Computer Architecture", Prentice Hall,2000.
5. William Stallings, "Computer Organization and Architecture, Designing for Performance", Pearson Education, 8th Edition, 2010.

EC5029	VLSI DESIGN	L T P C
		3 0 0 3

OBJECTIVES:
- To learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies
- To familiarize with the different FPGA architectures.

UNIT I   MOS TRANSISTOR PRINCIPLES   9
MOSFET and Current Equations, Clock Distance Modeling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore's constant. Case study: Study of technology development in MOS.

UNIT II   COMBINATIONAL LOGICCIRCUITS   9
Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic .Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic.

UNIT III   SEQUENTIAL LOGIC CIRCUITS   9
Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Memory Architectures.

UNIT IV   ARITHMETIC BUILDING BLOCKS   9
Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multiplier.

UNIT V   IMPLEMENTATION STRATEGIES   9
Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

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COURSE OUTCOMES:

CO1: Ability to comprehend and appreciate the significance and role of this course in the present contemporary world

CO2: At the end of the course students will be in a position to apply the basics of VLSI design, testing and different FPGA architectures.

TEXT BOOK:
1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A design perspective". Second Edition, Prentice Hall of India, 2003.

REFERENCES:
1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI DESIGN", A system Perspective, Addision Wesley, 2nd Edition, 2004.
2. A.Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Prentice Hall of India, 3rd Edition, 2007.
3. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, 2005.

GE5073	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I   FUNDAMENTALS OF PRODUCT DEVELOPMENT   9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

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UNIT II   REQUIREMENTS AND SYSTEM DESIGN   9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III   DESIGN AND TESTING   9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV   SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT   9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements **- Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V   BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY   9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Define, formulate and analyze a problem.
CO2: Solve specific problems independently or as part of a team.
CO3: Gain knowledge of the Innovation & Product Development process in the Business
       Context.
CO4: Work independently as well as in teams.
CO5: Manage a project from start to finish.

TEXTBOOKS:
1.   Book specially prepared by NASSCOM as per the MoU.
2.   Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3.   John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:
1.   Hiriyappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2.   Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3.   Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.

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4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

BM5022	VIRTUAL INSTRUMENTATION	L T P C
		2 0 2 3

OBJECTIVES

- To introduce virtual instrumentation concepts and applications.
- To train to program virtual instrumentation software for biomedical applications

UNIT I   INTRODUCTION   9

History of Virtual Instrumentation(VI), advantages, block diagram and architecture of a virtual instrument, Programming paradigms – Virtual Instrumentation - LabVIEW software – LabVIEW basics – LabVIEW environment.

UNIT II   VI USING LABVIEW   9

Creating, Editing and debugging a VI in LabVIEW – Creating a sub VI – Loops and charts – Case and sequence structures – File I/O – VI customization.

UNIT III   DATA ACQUISITION AND CONTROL IN VI   9

Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems

UNIT IV   INSTRUMENT INTERFACES   9

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

UNIT V   APPLICATION OF VI IN BIOMEDICAL ENGINEERING   9

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), Air Flow and Lung Volume, Heart Rate variability analysis, Noninvasive Blood Pressure Measurement, Biofeedback, Virtual Reality & 3D graphical modeling, Virtual Prototyping.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to

CO1: To comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2: Identify salient traits of a virtual instrument.
CO3: Understand the use of VI for data acquisition.
CO4: Experiment, analyze and document different types of interfaces.
CO5: Apply the virtual instrumentation technologies for medical applications.

TEXT BOOKS:

1. Gary Johnson, "LABVIEW Graphical Programming", McGraw Hill, 2nd Edition,1997.
2. Lisa K. Wells and Jeffrey Travis, "LABVIEW for Everyone", PHI, 1997.
3. Skolkoff, "Basic concepts of LABVIEW 4", PHI, 1998.
4. Jerome, Jovitha, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2010.

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5. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata Mc
   Graw – Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.

REFERENCES:
1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement,
   Instrumentation and Control", Newnes, 2000.
2. S. Gupta, J.P. Gupta," PC Interfacing for Data Acquisition and Process Control", ISA, 2nd
   Edition, 1994.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.
4. Jon B. Olansen, Eric Rosow, "Virtual Bio-Instrumentation: Biomedical, Clinical, and
   Healthcare Applications in LabVIEW" Pearson Education, 2001.

Course Outcomes	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√			√							√
CO2	√	√	√		√							√
CO3		√	√	√	√						√	√
CO4		√	√	√	√						√	√
CO5				√	√	√				√	√	√

BM5023   **BIOSTATISTICS**   **L T P C**
                                                                                                        3 0 0 3

OBJECTIVES:
- To introduce the techniques used in statistical & regression analysis.
- To compare the various parameters used in statistical significance

UNIT I   INTRODUCTION   9
Biostatistics - Statistical problems in Biomedical research– Basic concepts: Population,
Samples and Variables - Basic probability, likelihood & odds, distribution variability.

UNIT II   STATISTICAL PARAMETERS   9
Statistical parameters p-values, computation and level chi square test and distribution.

UNIT III   REGRESSION ANALYSIS   9
Regression – Linear regression – Multiple linear regression – Multiple colinearity, Determining
Best regression – Nonlinear regression – Logistic regression – Poison regression.

UNIT IV   INTERPRETING DATA   9
Life table: Interpreting life tables clinical trails, epidemical reading and interpreting of
epidemical studies, application in community health.

UNIT V   META ANALYSIS   9
META analysis for research activities, purpose and reading of META analysis, Forest graph,
Funnel plots, Radial plots, L'Abbe plots, Criticisms of Meta analysis.

                                                                          TOTAL:45 PERIODS

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COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

CO1: Classify common statistical tests and tools.

CO2: Distinguish between p-values and confidence intervals as measures of statistical significance.

CO3: Interpret commonly used regression analysis.

CO4: Explain the data tables and its interpretations in community health.

CO5: Evaluate commonly used statistical and epidemiologic measures.

TEXT BOOKS:

1. Joseph A. Ingel finger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware 'Biostatistics in Clinical Medicine', Singapore, 3rd Edition, 1994.

2. Gerald van Belle, Lloyd D. Fisher, Patrick J. Heagerty, Thomas Lumley, 'Biostatistics: A Methodology For the Health Sciences', John Wiley & Sons, 2004.

REFERENCES:

1. Julien I.E. Hoffman, 'Biostatistics for Medical and Biomedical Practitioners', Elsevier Press, 2015.

2. James F. Jekel, 'Epidemiology, Biostatistics, and Preventive Medicine', Elsevier Health Sciences, 2007.

3. Ray M. Merrill, 'Fundamentals of Epidemiology and Biostatistics, Jones & Bartlett Learning, 2013.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√							√
CO2	√	√	√		√							√
CO3	√	√	√		√							√
CO4					√	√	√	√			√	√
CO5					√	√	√	√			√	√

BM5024   **INTERNET OF THINGS IN MEDICINE**   **L T P C**
                                                                 3 0 0 3

OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I   FUNDAMENTALS OF IoT   9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT

Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II   IoT PROTOCOLS   9
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT III   DESIGN AND DEVELOPMENT   9
Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV   DATA ANALYTICS AND SUPPORTING SERVICES   9
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V   APPLICATIONS OF IOT IN MEDICINE   9
NSUM Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An IoT Model for Neuro sensors, AdaBoost with feature selection using IoT for somatic mutations evaluation in Cancer, A Fuzzy-Based expert System to diagnose Alzheimer's Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments, Approach to predict Diabetic Retinopathy through data analytics, Diagnosis of chest diseases using artificial neural networks.

                                                                                                  TOTAL : 45 PERIODS
COURSE OUTCOMES:
Upon completion of the course, the student will be able to
CO1: Explain the concept of IoT.
CO2: Analyze various protocols for IoT.
CO3: Design a PoC of an IoT system using Rasperry Pi/Arduino.
CO4: Apply data analytics and use cloud offerings related to IoT.
CO5: Analyze applications of IoT in real time scenario.

TEXTBOOKS:
 1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
 2. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, "Internet of Things and Personalized Healthcare Systems", Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

REFERENCES:
 1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

Attested

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2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. Jan Ho¨ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. Michael Margolis, Arduino Cookbook, "Recipes to Begin, Expand, and Enhance Your Projects", O'Reilly Media, 2nd Edition.

COURSE OUTCOMES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√							√
CO2	√	√	√		√							√
CO3				√	√						√	√
CO4				√	√	√	√	√			√	√
CO5				√	√	√	√	√	√	√	√	√

AD5091   **CONSTITUTION OF INDIA**   **L T P C**
                                                                      3 0 0 0

OBJECTIVES:
- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I   INTRODUCTION   9
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II   CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES   9
Fundamental Rights-Right to Equality-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 III   ORGANS OF GOVERNANCE   9
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV   EMERGENCY PROVISIONS   9
Emergency Provisions - National Emergency, President Rule, Financial Emergency

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UNIT V   LOCAL ADMINISTRATION   9

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 ZilaPachayat- Position and role-Block level- Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

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

OUTCOMES:
CO1: Able to understand history and philosophy of Indian Constitution.
CO2: Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3: Able to understand powers and functions of Indian government.
CO4: Able to understand emergency rule.
CO5: Able to understand structure and functions of local administration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

AD5092	VALUE EDUCATION	L T P C
		3 0 0 0

OBJECTIVES:
- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I   INTRODUCTION TO VALUE EDUCATION   9

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 II   IMPORTANCE OF VALUES   9

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

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UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour 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.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45PERIODS

OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							√	√				√
CO2							√	√	√			√
CO3							√	√	√			√
CO4							√	√				√
CO5							√	√				√

REFERENCES:

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

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AD5093 **PEDAGOGY STUDIES** **L T P C**
3 0 0 0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.

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- Identify the Research gaps in pedagogy.

UNIT I   INTRODUCTION AND METHODOLOGY   9
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 II   THEMATIC OVERVIEW   9
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III   EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES   9
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 IV   PROFESSIONAL DEVELOPMENT   9
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 V   RESEARCH GAPS AND FUTURE DIRECTIONS   9
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.
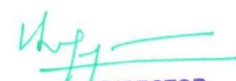
TOTAL: 45PERIODS

OUTCOMES:
- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												√
CO2												√
CO3												√
CO4												√
CO5												√

REFERENCES:
1. Ackers J, Hardman F, "Classroom interaction in Kenyan primary schools", Compare, 2001.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies",2004.
3. Akyeampong K, "Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country", Report 1. London: DFID,2004.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development",2013.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education. Oxford and Boston" Blackwell, 2001.

AD5094	STRESS MANAGEMENT BY YOGA	L T P C
		3 0 0 0

OBJECTIVES:
- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I   INTRODUCTION TO YOGA   9
Definitions of Eight parts of yog. (Ashtanga)

UNIT II   YAM   9
Do`s and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III   NIYAM   9
Do`s and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV   ASAN   9
Various yog poses and their benefits for mind & body
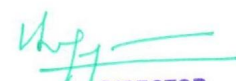
UNIT V   PRANAYAM   9
Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45PERIODS

COURSE OUTCOMES:
CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through Yog Asans
CO5 – Learn breathing techniques through Pranayam

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							√	√				√
CO2							√	√				√
CO3							√	√				√
CO4							√	√				√
CO5							√	√				√

REFERENCES:

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

**AD5095   PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT L T P C
SKILLS   3 0 0 0**

OBJECTIVES:
- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I   NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I   9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II   NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II   9
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III   APPROACH TO DAY TO DAY WORK AND DUTIES   9
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 IV   STATEMENTS OF BASIC KNOWLEDGE – I   9
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V   PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA   9
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45PERIODS

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COURSE OUTCOMES:
CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5**:** To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

REFERENCES:
1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringar-vairagya, New Delhi,2010.
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

AD5097   **ESSENCE OF INDIAN KNOWLEDGE TRADITION**   **L T P C**
                                                                          3 0 0 0
COURSE OBJECTIVES
The course will introduce the students to
- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I   INTRODUCTION TO CULTURE   9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II   INDIAN LANGUAGES AND LITERATURE   9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III   RELIGION AND PHILOSOPHY   9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

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UNIT IV   FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)   9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V   EDUCATION SYSTEM IN INDIA   9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45PERIODS

COURSE OUTCOMES
After successful completion of the course the students will be able to
- Understand philosophy of Indian culture.
- Distinguish the Indian languages and literature.
- Learn the philosophy of ancient, medieval and modern India.
- Acquire the information about the fine arts in India.
- Know the contribution of scientists of different eras.
- Understand education systems in India

REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

PROGRESS THROUGH KNOWLEDGE

AD5098   SANGA TAMIL LITERATURE APPRECIATION   L T P C
3 0 0 0

Course Objectives: The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.

2.'Agathinai' and 'Purathinai' in Sanga Tamil Literature.

3.'Attruppadai' in Sanga Tamil Literature.

4.'Puranaanuru' in Sanga Tamil Literature.

5.'Pathitru paththu' in Sanga Tamil Literature.

Attested

UNIT I   SANGA TAMIL LITERATURE AN INTRODUCTION   9

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar- Tamil Sangam Literature'sparables.

UNIT II   'AGATHINAI' AND 'PURATHINAI'   9

Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History of Culture from Agathinai–Purathinai–Classification–Mesaage to Society from Purathinai.

UNITIII   'ATTRUPPADAI'.   9

Attruppadai Literature–Attruppadai in'Puranaanuru'-Attruppadaiin 'Pathitru paththu'-Attruppadai in 'Paththu aattu'.

UNITIV   'PURANAANURU'   9

Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.

UNITV   'PATHITRU PATHTHU'   9

Pathitrupaththu in'Ettuthogai'–Pathitru paththu's Parables–Tamil dynasty:Valor, Administration, Charity in Pathitru paththu- Mesaage to Society from Pathitru paththu.

TOTAL (L:45) = 45 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.

2. Differentiate 'Agathinai' and'Purathinai'in their personal and societal life.

3. Appreciate and apply the messages in 'Attruppadai' in their personal and societal life.

4. Appreciate and apply the messages in 'Puranaanuru' in their personal and societal life.

5. Appreciate and apply the messages in 'Pathitru paththu' in their personal and societal life.

REFERENCES:

1. Sivaraja Pillai,The Chronology of the Early Tamils,Sagwan Press,2018.

2. Hank Heifetz and George L. Hart, The Purananuru, Penguin Books,2002.

3. Kamil Zvelebil,The Smile of Murugan:On Tamil Literature of South India, Brill Academic Pub,1997.

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4. George L. Hart, Poets of theTamil Anthologies: Ancient Poems of Love and War, Princeton University Press,2015.

5. Xavier S.Thani Nayagam, Land scape and poetry:a study of nature in classical
   Tamil poetry, Asia Pub.House, 1967.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1									0.9						0.6
2									0.9						0.6
3									0.9						0.6
4									0.9						0.6
5									0.9						0.6

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171 **LANGUAGE AND COMMUNICATION** **LT P C**
                                                      3 0 0 3
COURSE DESCRIPTION
This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives
- ✓ To familiarize students with the concept of communication using linguistic and non linguistic resources.
- ✓ To help students ask critical questions regarding facts and opinions.
- ✓ To provide students with the material to discuss issues such as language and power structures.
- ✓ To help students think critically about false propaganda and fake news.
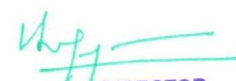
Learning Outcomes
- ➢ Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- ➢ Students will be able to analyse communication in terms of facts and opinions.
- ➢ Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I   LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9
a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy

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d) Communicative Competency, context and situation, combination of linguistic and non-linguistic
   elements of communication

UNIT II   STRUCTURE OF WRITING/CONVERSATION: **9**
a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies
d) Coherence and Cohesion in speech and writing

UNIT III   POWER STRUCTURE AND LANGUAGE USE: **9**
a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV   MEDIA COMMUNICATION: **9**
a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V   PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: **9**
a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

                                  TOTAL : 45 PERIODS

TEXT BOOKS:
1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

HU5172   VALUES AND ETHICS   L T P C
                                                3 0 0 3
OBJECTIVES:
- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I   DEFINITION AND CLASSIFICATION OF VALUES   9
Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous-
Economic-Social-Aesthetic-Moral and Religious values

UNIT II   CONCEPTS RELATED TO VALUES   9
Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III   IDEOLOGY OF SARVODAYA   9
Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV   SUSTENANCE OF LIFE   9
The Problem of Sustenance of value in the process of Social, Political and Technological
Changes

UNIT V   VIEWS ON HIERARCHY OF VALUES   9
The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya
and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:
> CO1: Able to understand definition and classification of values.
> CO2: Able to understand purusartha.
> CO3: Able to understand sarvodaya idea.
> CO4: Able to understand sustenance of life.
> CO5: Able to understand views of hierarchy of values.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								✓	✓			✓
CO2								✓	✓			✓
CO3								✓	✓			✓
CO4								✓	✓			✓
CO5								✓	✓			✓

TEXTBOOKS:
1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

HU5173   HUMAN RELATIONS AT WORK   L T P C
3 0 0 3

OBJECTIVES:
- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.

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- Identify the essential qualities for progressing in career.

UNIT I   UNDERSTANDING AND MANAGING YOURSELF   9
Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II   DEALING EFFECTIVELY WITH PEOPLE   9
Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III   STAYING PHYSICALLY HEALTHY   9
Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV   STAYING PSYCHOLOGICALLY HEALTHY   9
Managing Stress and Personal Problems, Meditation.

UNIT V   DEVELOPING CAREER THRUST   9
Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓		✓	✓			✓
CO2									✓	✓		✓
CO3						✓		✓	✓			✓
CO4								✓				✓
CO5								✓	✓	✓		✓

TEXT BOOK:
1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:
1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

HU5174   **PSYCHOLOGICAL PROCESSES**   **L T P C**
                                                         3 0 0 3

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

➢ To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
➢ To learn to use the various kinds of thinking in a formal context.
➢ To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitve and Perceptual – Industrial and Organizational.

UNIT 2: SENSORY & PERCEPTUAL PROCESSES

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation - Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

UNIT 5: PERSONALITY & INTELLIGENCE

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

References

1. Morgan, C.T.and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W.Passer, Ronald E.smith (2007), Psychology: The science of mind and Behavior,3rd Edition Tata McGraw-Hill Edition.
4. Robert S.Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence. personality. psychopathology. and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality
   and intelligence (pp. 249-284). New York: Plenum Press.
6. Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg. & P. Ruzgis (Eds.). Personality and intelligence
   (pp. 188-21 7). New York: Cambridge University Press.

- De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

HU5175	EDUCATION, TECHNOLOGY AND SOCIETY	L T P C
		3 0 0 3

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

➢ To help learners understand the basics of different types of technology utilised in the field of education
➢ To make them realize the impact of education in society
➢ To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

➢ Understand the various apps of technology apps and use them to access, generate and present information effectively.
➢ Apply technology based resources and other media formats equitably, ethically and legally.
➢ Integrate their technical education for betterment of society as well as their personal life.

UNIT I   INDIAN EDUCATION SYSTEM

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II   LEARNING THEORIES

Learning Theories – Behaviorism – Cognitivism – Social Constuctivism – Humanism Learning Styles – Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

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UNIT III   TECHNOLOGICAL ADVANCEMENTS

Web tools – Social media in education – elearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV   EDUCATIONAL TECHNOLOGY

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V   ETHICAL IMPLICATIONS

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)

(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)

(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)

(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)

(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts.   (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

HU5176   **PHILOSOPHY**   **L T P C**
                                                                                 3 0 0 3
OBJECTIVES

* To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
* To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
* To bridge the gap between the sciences and humanities through introspective analyses.
* To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

UNIT I KNOWLEDGE 9

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

UNIT II ORIGIN 9

Origin of Universe And Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittriya Upanishad.

UNIT III WORD 9

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

UNIT IV KNOWLEDGE AS POWER/OPPRESSION 9

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

UNIT V SELF KNOWLEDGE/BRAHMAN 9

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:
1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

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HU5177   **APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE**   **L T P C**
3 0 0 3

UNIT I   INTRODUCTION   7
Nature and fields.

UNIT II   PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS   9
Job analysis; fatigue and accidents; consumer behavior.

UNIT III   PSYCHOLOGY AND MENTAL HEALTH   11
Abnormality, symptoms and causes psychological disorders

UNIT IV   PSYCHOLOGY AND COUNSELING   7
Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of
Counseling.

UNIT V   PSYCHOLOGY AND SOCIAL BEHAVIOUR   11
Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication,
conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS
1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New
   Jersey:Pearson/Prentice Hall
2. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New
   York: Pearson
3. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson
   Education
4. Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.).
   Upper Saddle River, NJ: Prentice Hall

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271   **GENDER, CULTURE AND DEVELOPMENT**   **L T P C**
3 0 0 3

COURSE DESCRIPTION
This course offers an introduction to Gender Studies that asks critical questions about the
meanings of sex and gender in Indian society. The primary goal of this course is to familiarize
students with key issues, questions and debates in Gender Studies, both historical and
contemporary drawing from Indian literature and media studies, to examine cultural
assumptions about sex, gender, and sexuality. This course integrates analysis of current events
through student presentations, aiming to increase awareness of contemporary and historical
experiences of women, and of the multiple ways that sex and gender interact with class, caste
and other social identities. This course also seeks to build an understanding of the concepts of
gender, gender-based violence, sexuality, and rights and their impact on development through a
number of discussions, exercises and reflective activities.

Objectives
- ✓ To familiarize students with the concepts of sex and gender through literary and media texts.
- ✓ To help students ask critical questions regarding gender roles in society.
- ✓ To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
- ✓ To help students think critically about gender based problems and solutions.

Learning Outcomes
- ➢ Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
- ➢ Students will be able to analyse current social events in the light of gender perspectives.
- ➢ Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I: Introduction to Gender
- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender

Texts:
1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations
- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour

Texts:
1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)
2. Video: Witness: Freeing Women From Cleaning Human Waste (2014, HRW, Manual Scavenging, India)

UNIT III: Gender Development Issues
- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming

Texts:
1. The Many Faces of Gender Inequality (Essay, Amartya Sen, Frontline, Volume 18 - Issue 22, Oct. 27 - Nov. 09, 2001)
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

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UNIT IV: Gender-based Violence
- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective

Texts:
1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture
- Gender and Film
- Gender, Media and Advertisement

Texts:
1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:
Discussion & Classroom Participation: 20%
Project/Assignment: 30%
End Term Exam: 50%

HU5272	ETHICS AND HOLISTIC LIFE	L T P C
		3 0 0 3

OBJECTIVES:
- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I   HUMAN LIFE, ITS AIM AND SIGNIFICANCE
The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II   CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT
Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Self-dependency, Activeness, Development of positive attitude.

UNIT III   HARMONY IN PERSONAL AND SOCIAL LIFE:
Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and

welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE

Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

Science, Technology, Consumerism, Relation with Nature and Environment, New dimension of Global Harmony: Democracy, Equality, Social Justice

TOTAL:45 PERIODS

OUTCOMES:

On completion of the course, the students will be able to:

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

| HU5273 | LAW AND ENGINEERING | L T P C
3 0 0 3 |

UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9

Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II LAWS 9

Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III   BUSINESS ORGANISATIONS   9

Sole traders (Business has no separate identity from you, all business property belongs to you). Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

UNIT IV   LAW AND SOCIETY   9

Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence**.**

UNIT V   CASE STUDIES   9

Important legal disputes and judicial litigations

TOTAL: 45 PERIODS

HU5274	**FILM APPRECIATION**	**L T P C**
		3 0 0 3

COURSE DESCRIPTION

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

OBJECTIVES:
- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I   THE COMPONENTS OF FILMS   9

Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

UNIT II   EVOLUTION OF FILM   9

History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurists, Feminist, Psychonalyic, Idealogical Theories.

UNIT III   FILMS ACROSS THE WORLD   9

European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.

UNIT IV   INDIAN FILMS   9

The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.

UNIT V INTERPRETING FILMS 9

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS

OUTCOMES

On completion of the course, the students will be able to:
- Recognize types of films, their impact on society and their roles in our lives.
- Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
- Interpret the underlying messages in the movies.

Teaching Methods
- Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Evaluation
- As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)
- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES
1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971
4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983
5. The Encyclopedia of Indian Cinema Edited by Ashish Rajadhyaksha and Paul Willemen, BFI, 1994.

HU5275 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS L T P C
3 0 0 3

OBJECTIVES
- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

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CONTENTS : -

UNIT I   LANGUAGE AND LINGUISTICS: AN OVERVIEW   9
Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive,universal-Human Language – Animal Language – Sign Language- Computers and Language.

UNIT II   MORPHOLOGY - WORDS OF LANGUAGE   9
Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems –inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

**UNIT III   SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE
              MEANING OF LANGUAGE   9**
Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

UNIT IV   PHONETICS – THE SOUNDS OF LANGUAGE   9
Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

UNIT V   APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE 9
Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

Teaching Methods :
Lectures, discussion.

Evaluation Internal and External :
Internal: 2 written tests + assignments, seminars, project (50+15+15+20).
External: A 3 hour written exam (50 marks)

REFERENCES :
1.Victoria   Fromkin,   Robert   Rodman,   Nina   Hyams.2019.An   Introduction   to Language.USA.CENGAGE.11th edition
2. Cook. G,2003. Applied linguistics.UK: Oxford University Press.

**HU5276   UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE L T P C
                                                                  3 0 0 3**
OBJECTIVES
*   To internalize the importance of language by understanding its role in the transformation of man.
*   To look at language, literature and culture as locus of identity and change.
*   To extract meaning from existing literatures and cultures.
*   To identify meanings in modern life by reconnecting with lost cultures.

UNIT 1   INTRODUCTION

Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral - Logography. Reading out literature to young children- Edmund J Farrell.

UNIT 2.   READING CULTURE

Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel's ' The night of the Scorpion' . 'Nothing's Changed'- Tatamkhulu Afrika-Apartheid. Ruskin Bond- 'Night train at Deoli'- How real life is different from movies.

UNIT 3.   IDENTIFYING MEANING

Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar's 'Jagat Mithya'- the world as an illusion. The Indian version as 'meaninglesss meaning'.

UNIT 4.   POST MODERNISM

'If on a winter's night a traveler'- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

UNIT 5.   RETURNING TO PICTURES

Literature of the present- Emphasis on the visual world. Twitterature. SMS. Whatsapp language. Consumer culture. Change in fixed gender notions. Interactive sessions. Introspection.

Reading list
1. Bond, Ruskin: 'Night train at Deoli'
2. Ezekiel, Nissim: ' The Night of the Scorpion'
3. Afrika,Tatamkhulu: 'Nothing's Changed'
4. Barthes, Roland: *Mythologies*
5. Shankaracharya: *Viveka Chudamani*
6. Camus, Albert- *The Myth of Sisyphus*
7. Calvino, Italo: *If on a winter's night a traveler*
8. Farrell, Edmund J: 'Listen, my children, and you shall read'

Outcome
- Can identify the connections among language, literature and culture.
- Is able to relate between seemingly different aspects of life.
- Understands the fractions in modern life and can assimilate meanings.