ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. BIOMEDICAL ENGINEERING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES:
THE OBJECTIVES OF THE B.E BIO MEDICAL ENGINEERING PROGRAMME IS BROADLY DEFINED ON THE FOLLOWING:

1. Prepare the students to comprehend the fundamental concepts in Bio Medical Engineering
2. Enable the students to relate theory with practice for problem solving
3. Enable the students to critically analyse the present trends and learn and understand future issues
4. Motivate the students to continue to pursue lifelong learning as professional engineers and scientists and effectively communicate the technical details and to work effectively in teams of multidisciplinary nature and to apply Bio Medical Engineering solutions to the society
5. 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
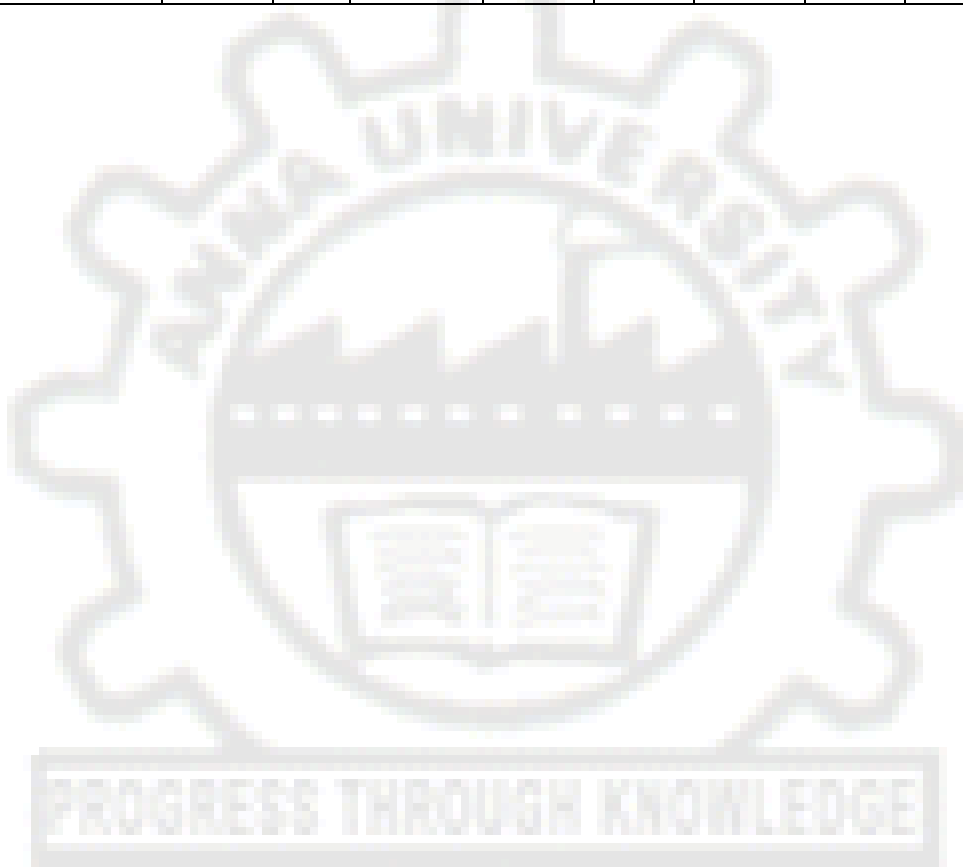
PROGRAM OUTCOMES:
STUDENTS WILL BE ABLE TO:

a) Apply life science , engineering and mathematical concepts in modeling and design of bio medical systems of varying complexity
b) Critically analyse a problem, identify and formulate solution in the field of Bio Medical Engineering taking into consideration the current trends and future issues
c) Design a component, system or a process to meet the needs within realistic constraints such as economic , safety and sustainability in the field of Bio Medical Engineering
d) Work effectively in teams of multidisciplinary nature to accomplish a goal
e) Communicate efficiently to an audience of multidisciplinary nature and to prepare technical documents and to present effectively
f) Analyse and understand the impact of healthcare delivery on individuals and society
g) Understand the need and possess the ability for lifelong learning to have continuous professional development
h) Ability to understand ethical and professional responsibilities
i) Demonstrate advanced knowledge of a selected area within Bio Medical Engineering
j) Critically analyse the current healthcare systems and develop innovative solutions

Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

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									
	a	b	c	d	e	f	g	h	i	j
1.	√	√	√					√		
2.	√	√	√	√		√		√	√	√
3.	√	√	√	√		√	√	√	√	√
4.			√	√	√	√	√	√	√	√
5.		√	√	√	√	√	√	√	√	√

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MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES
A broad relation between the programme outcomes and the course outcomes is given in the following table:

		Course Title	POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
YEAR1	SEM 1	Foundational English	√				√	√	√	√	√	√
		Mathematics –I	√	√	√				√		√	√
		Engineering Physics	√	√	√				√		√	√
		Engineering Chemistry	√	√	√				√		√	√
		Engineering Graphics	√									
		Basic Sciences Laboratory	√	√	√		√		√		√	√
		Engineering Practices Laboratory	√	√	√		√		√		√	√
	SEM 2	Technical English	√				√	√	√	√	√	√
		Mathematics –II	√	√	√				√		√	√
		Anatomy and Physiology	√	√		√	√	√		√	√	
		Electron Devices and Circuits	√	√	√				√			
		Computing Techniques	√	√	√		√		√		√	√
		Circuit Theory	√	√	√				√		√	√
		Devices and Circuits Laboratory	√	√	√		√		√		√	√
		Computer Practices Laboratory	√	√	√		√		√		√	√
YEAR 2	SEM 3	Transform Techniques and Partial Differential Equations	√	√	√		√		√		√	√
		Environmental Science and Engineering	√	√	√		√		√		√	√
		Fundamentals of Biochemistry	√	√		√		√	√	√		
		Sensors and Measurements	√	√	√					√	√	√
		Signals and Systems	√	√	√				√		√	√
		Electrical Engineering	√	√	√							
		Biochemistry and Human Physiology Laboratory	√	√	√	√		√		√		
		Sensors and Measurements Laboratory	√	√	√	√		√	√	√	√	√

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Year	Sem	Course										
	SEM 4	Probability and Random processes	√	√					√			√
		Biomedical Instrumentation and Measurements	√	√	√	√		√	√		√	√
		Analog and Digital Communication	√	√	√	√	√					
		Digital Electronics and System Design	√	√	√	√			√		√	√
		Operational Amplifiers and Analog Integrated circuits	√	√	√				√		√	√
		Control System for Bio Medical Engg.	√	√	√				√			√
		Biomedical Instrumentation Laboratory		√	√			√		√	√	√
		Digital and Integrated Circuits Laboratory	√	√	√	√						√
YEAR 3	SEM 5	Hospital Management		√	√	√	√	√			√	√
		Diagnostic and Therapeutic Equipment I	√	√		√	√	√	√	√		√
		Microprocessors and Microcontrollers	√	√	√				√		√	√
		Discrete Time Signal Processing	√	√	√				√		√	√
		Data structures and Object Oriented Programming in C++		√				√	√		√	√
		Professional Elective – I										
		Microcontroller and Interfacing laboratory	√	√	√		√		√		√	√
		Discrete Time Signal Processing Laboratory	√	√	√		√		√		√	√
	SEM 6	Bio Mechanics	√	√	√	√		√		√	√	√
		Diagnostic and Therapeutic Equipment –II	√	√		√		√	√	√		√
		Pathology and Microbiology	√	√		√	√	√				√
		Radiological Equipment		√	√	√			√	√	√	
		Professional Elective -II										
		Professional Elective –III										
		Diagnostic and Therapeutic Equipment Laboratory	√	√		√		√		√		√
		Pathology and Microbiology Laboratory	√	√		√	√	√				√

YEAR 4		Course										
YEAR 4	SEM 7	Medical Informatics		√					√	√		√	√
		Pattern Recognition and Neural Networks	√	√	√					√		√	√
		Principles of Digital Image Processing	√	√				√	√	√		√	√
		Professional Elective -IV											
		Professional Elective -V											
		Open Elective-I											
		Medical Image Processing Laboratory	√	√		√	√	√	√		√	√
		Mini Project	√	√	√	√	√	√	√	√	√	√
		Hospital Training						√	√	√	√	√	√
	SEM 8	Professional Elective -VI											
		Professional Elective – VII											
		Open Elective-II											
		Project Work	√	√	√	√	√	√	√	√	√	√

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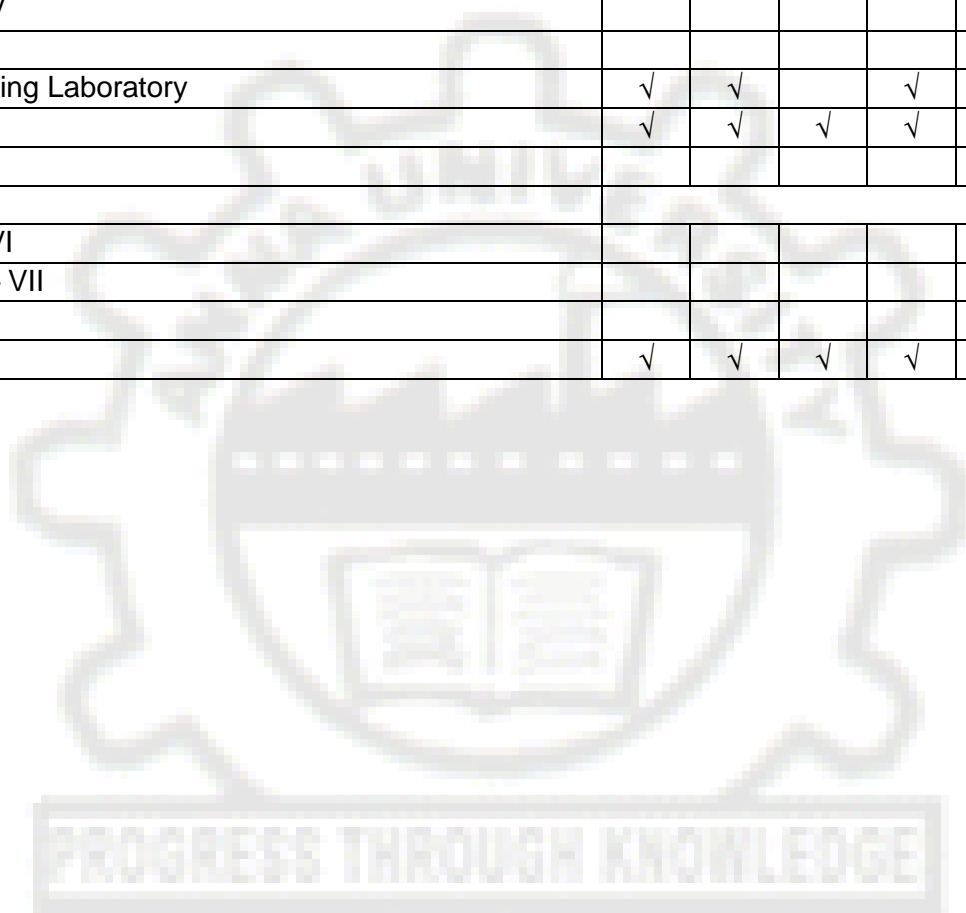
Electives List										
Course Title	POa	POb	POc	POd	POe	POf	POg	POh	POi	POj
Advanced Bioanalytical and therapeutic Techniques		√	√	√		√			√	
Advanced Microcontrollers	√		√						√	
Biomaterials and Artificial Organs	√	√	√		√	√				√
MEMS and its Biomedical Applications	√	√	√	√		√			√	√
Bio Signal Processing	√	√	√	√					√	√
Biomaterials and Characterisation	√	√	√		√	√	√			√
Biometric Systems			√	√				√	√	√
Brain Computer Interface and Applications	√	√	√	√		√				√
Computer Hardware and interfacing		√	√						√	√
Realtime and Embedded systems		√	√			√			√	√
Medical Optics	√	√	√	√	√				√	√
Medical Physics	√	√	√	√					√	√
Neural Engineering	√	√			√			√	√	√
Physiological Modeling	√	√		√		√		√		√
Principles of Tissue Engineering		√		√			√	√	√	√
Rehabilitation Engineering	√	√	√	√		√		√		√
Engineering Ethics and Human Values										
Total Quality Management			√		√		√			
Cryptography and Network Security			√						√	√
Electromagnetic Interference and Compatibility		√		√	√	√	√		√	√
Foundations for Nanoelectronics	√	√				√			√	√
Multimedia Compression and Networks		√					√	√	√	√
Robotics		√	√	√					√	√
Soft computing and Applications		√	√				√		√	√
Computer Architecture and Organization		√	√	√	√		√			√
VLSI Design			√	√		√	√			√
Foundation Skills in Integrated Product		√	√	√	√		√			√

ELECTIVES

6

	Development										
	Disaster Management	√	√				√	√			
	Human Rights						√		√		
	Internet and Java		√	√							√	√
	Body Area Networks	√	√	√	√		√		√	√	
	Virtual Reality		√	√			√	√	√	√	
	Wearable Systems	√	√	√	√	√	√		√	√	
	Speech Processing	√	√	√							√	√

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Attested

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B. E. BIOMEDICAL ENGINEERING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	MA7151	Mathematics –I	BS	4	4	0	0	4
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE7152	Engineering Graphics	ES	5	3	2	0	4
PRACTICALS								
6.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
7.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**27**	**17**	**2**	**8**	**22**

SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7251	Technical English	HS	4	4	0	0	4
2.	MA7251	Mathematics –II	BS	4	4	0	0	4
3.	BM7201	Anatomy and Physiology	PC	3	3	0	0	3
4.	EC7252	Electron Devices and Circuits	ES	3	3	0	0	3
5.	GE7151	Computing Techniques	ES	3	3	0	0	3
6.	EC7251	Circuit Theory	ES	4	2	2	0	3
PRACTICALS								
7.	EC7261	Devices and Circuits Laboratory	ES	4	0	0	4	2
8.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**19**	**2**	**8**	**24**

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SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM7301	Fundamentals of Biochemistry	PC	3	3	0	0	3
2.	BM7302	Sensors and Measurements	PC	3	3	0	0	3
3.	EC7355	Signals and Systems	ES	4	2	2	0	3
4.	EE7305	Electrical Engineering	ES	3	3	0	0	3
5.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
6.	MA7358	Transform Techniques and Partial Differential Equations	BS	4	4	0	0	4
PRACTICALS								
7.	BM7311	Biochemistry and Human Physiology Laboratory	PC	4	0	0	4	2
8.	BM7312	Sensors and Measurements Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**18**	**2**	**8**	**23**

SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM7401	Analog and Digital Communication	ES	3	3	0	0	3
2.	BM7402	Biomedical Instrumentation and Measurements	PC	3	3	0	0	3
3.	BM7403	Control System for Bio Medical Engineering.	PC	3	3	0	0	3
4.	EC7353	Digital Electronics and System Design	PC	3	3	0	0	3
5.	EC7452	Operational Amplifiers and Analog Integrated Circuits	PC	3	3	0	0	3
6.	MA7356	Probability and Random Processes	BS	4	4	0	0	4
PRACTICALS								
7.	BM7411	Bio Medical Instrumentation Laboratory	PC	4	0	0	4	2
8.	BM7412	Digital and Integrated Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM7501	Diagnostic and Therapeutic Equipment I	PC	3	3	0	0	3
2.	BM7502	Hospital Management	HS	3	3	0	0	3
3.	EC7352	Data structures and Object Oriented Programming In C++	ES	5	3	2	0	4
4.	EC7451	Microprocessors and Microcontrollers	PC	3	3	0	0	3
5.	EC7552	Discrete Time Signal Processing	PC	3	3	0	0	3
6.		Professional Elective – I	PE	3	3	0	0	3
PRACTICALS								
7.	BM7511	Microcontroller and Interfacing laboratory	PC	4	0	0	4	2
8.	EC7561	Discrete Time Signal Processing Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**18**	**2**	**8**	**23**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM7601	Bio Mechanics	PC	3	3	0	0	3
2.	BM7602	Diagnostic and Therapeutic Equipment –II	PC	3	3	0	0	3
3.	BM7603	Pathology and Microbiology	PC	3	3	0	0	3
4.	BM7604	Radiological Equipment	PC	3	3	0	0	3
5.		Professional Elective-II	PE	3	3	0	0	3
6.		Professional Elective-III	PE	3	3	0	0	3
PRACTICALS								
7.	BM7611	Diagnostic and Therapeutic Equipment Laboratory	PC	4	0	0	4	2
8.	BM7612	Pathology and Microbiology Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

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S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM7701	Medical Informatics	PC	3	3	0	0	3
2.	BM7702	Pattern Recognition and Neural Networks	PC	3	3	0	0	3
3.	EC7751	Principles of Digital Image Processing	PC	3	3	0	0	3
4.		Professional Elective -IV	PE	3	3	0	0	3
5.		Professional Elective -V	PE	3	3	0	0	3
6.		Open Elective - I *	OE	3	3	0	0	3
PRACTICALS								
7.	BM7711	Hospital Training #	EEC	4	0	0	4	2
8.	BM7712	Medical Image Processing Laboratory	PC	4	0	0	4	2
9.	BM7713	Mini Project #	EEC	6	0	0	6	3
			TOTAL	**32**	**18**	**0**	**14**	**25**

SEMESTER VIII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective -VI	PE	3	3	0	0	3
2.		Professional Elective -VII	PE	3	3	0	0	3
3.		Open Elective -II *	OE	3	3	0	0	3
PRACTICALS								
4.	BM7811	Project Work	EEC	20	0	0	20	10
			TOTAL	**29**	**9**	**0**	**20**	**19**

TOTAL NO. OF CREDITS:181

* Course from the curriculum of other UG programmes
 # The Contact periods will not appear in the slot time table

Attested

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Anna University, Chennai-600 025.

HUMANITIES AND SOCIAL SCIENCES (HS)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	HS7251	Technical English	HS	4	4	0	0	4
3.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
4.	BM7502	Hospital Management	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics –I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics-II	BS	4	4	0	0	4
6.	MA7358	Transform Techniques and Partial Differential Equations	BS	4	4	0	0	4
7.	MA7356	Probability and Random processes	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7152	Engineering Graphics	ES	5	3	2	0	4
2.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
3.	EC7252	Electron Devices and Circuits	ES	3	3	0	0	3
4.	GE7151	Computing Techniques	ES	3	3	0	0	3
5.	EC7251	Circuit Theory	ES	4	2	2	0	3
6.	EC7261	Devices and Circuits Laboratory	ES	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
8.	EC7355	Signals and Systems	ES	4	2	2	0	3
9.	EE7305	Electrical Engineering	ES	3	3	0	0	3
10.	BM7401	Analog and Digital Communication	ES	3	3	0	0	3
11.	EC7352	Data structures and Object Oriented Programming In C++	ES	5	3	2	0	4

PROFESSIONAL CORE (PC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM7201	Anatomy and Physiology	PC	3	3	0	0	3
2.	BM7301	Fundamentals of Biochemistry	PC	3	3	0	0	3
3.	BM7302	Sensors and Measurements	PC	3	3	0	0	3
4.	BM7311	Biochemistry and Human Physiology Laboratory	PC	4	0	0	4	2
5.	BM7312	Sensors and Measurements Laboratory	PC	4	0	0	4	2
6.	BM7402	Bio Medical Instrumentation and Measurements	PC	3	3	0	0	3
7.	EC7353	Digital Electronics and System design	PC	3	3	0	0	3
8.	EC7452	Operational Amplifiers and Analog Integrated Circuits	PC	3	3	0	0	3
9.	BM7403	Control System for Bio Medical Engineering.	PC	3	3	0	0	3
10.	BM7411	Bio Medical Instrumentation Laboratory	PC	4	0	0	4	2
11.	BM7412	Digital and Integrated Circuits Laboratory	PC	4	0	0	4	2
12.	BM7501	Diagnostic and Therapeutic Equipment –I	PC	3	3	0	0	3
13.	EC7451	Microprocessors and Microcontrollers	PC	3	3	0	0	3
14.	EC7552	Discrete Time Signal Processing	PC	3	3	0	0	3
15.	BM7511	Microcontroller And Interfacing Laboratory	PC	4	0	0	4	2
16.	EC7561	Discrete Time Signal Processing Laboratory	PC	4	0	0	4	2
17.	BM7601	Biomechanics	PC	3	3	0	0	3
18.	BM7602	Diagnostic and Therapeutic Equipment –II	PC	3	3	0	0	3
19.	BM7603	Pathology and Microbiology	PC	3	3	0	0	3
20.	BM7604	Radiological Equipment	PC	3	3	0	0	3

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
21.	BM7611	Diagnostic and Therapeutic Equipment Laboratory	PC	4	0	0	4	2
22.	BM7612	Pathology and Microbiology Laboratory	PC	4	0	0	4	2
23.	BM7701	Medical Informatics	PC	3	3	0	0	3
24.	BM7702	Pattern Recognition and Neural Networks	PC	3	3	0	0	3
25.	EC7751	Principles of Digital Image Processing	PC	3	3	0	0	3
26.	BM7712	Medical Image Processing Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM7001	Advanced Bio Analytical And Therapeutic Techniques	PE	3	3	0	0	3
2.	BM7002	Bio Signal Processing	PE	3	3	0	0	3
3.	BM7003	Biomaterials and Artificial Organs	PE	3	3	0	0	3
4.	BM7004	Biomaterials and Characterisation	PE	3	3	0	0	3
5.	BM7005	Biometric Systems	PE	3	3	0	0	3
6.	BM7006	Body Area Networks	PE	3	3	0	0	3
7.	BM7007	Brain Computer Interface and Applications	PE	3	3	0	0	3
8.	BM7008	Computer Hardware and Interfacing	PE	3	3	0	0	3
9.	BM7009	Medical Optics	PE	3	3	0	0	3
10.	BM7010	Medical Physics	PE	3	3	0	0	3
11.	BM7011	MEMS and its Biomedical Applications	PE	3	3	0	0	3
12.	BM7012	Neural Engineering	PE	3	3	0	0	3
13.	BM7013	Physiological Modeling	PE	3	3	0	0	3
14.	BM7014	Principles of Tissue Engineering	PE	3	3	0	0	3
15.	BM7015	Rehabilitation Engineering	PE	3	3	0	0	3
16.	BM7016	Virtual Reality	PE	3	3	0	0	3
17.	BM7017	Wearable Systems	PE	3	3	0	0	3
18.	EC7022	Internet and Java	PE	3	3	0	0	3
19.	EC7071	Advanced Microcontrollers	PE	3	3	0	0	3
20.	EC7072	Cryptography and Network Security	PE	3	3	0	0	3

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
21.	EC7073	Electro Magnetic Interference and Compatibility	PE	3	3	0	0	3
22.	EC7074	Foundations for Nano Electronics	PE	3	3	0	0	3
23.	EC7075	Multimedia Compression and Networks	PE	3	3	0	0	3
24.	EC7076	Real Time and Embedded Systems	PE	3	3	0	0	3
25.	EC7077	Robotics	PE	3	3	0	0	3
26.	EC7078	Soft Computing and Applications	PE	3	3	0	0	3
27.	EC7079	Speech Processing	PE	3	3	0	0	3
28.	EC7551	Computer Architecture and Organization	PE	3	3	0	0	3
29.	EC7651	VLSI Design	PE	3	3	0	0	3
30.	GE7071	Disaster Management	PE	3	3	0	0	3
31.	GE7072	Foundation Skills In Integrated Product Development	PE	3	3	0	0	3
32.	GE7074	Human Rights	PE	3	3	0	0	3
33.	GE7351	Engineering Ethics and Human Values	PE	3	3	0	0	3
34.	GE7652	Total Quality Management	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM7713	Mini Project	EEC	6	0	0	6	3
2.	BM7711	Hospital Training	EEC	4	0	0	4	2
3.	BM7811	Project Work	EEC	20	0	0	20	10

PROGRESS THROUGH KNOWLEDGE

Attested

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SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	4	3	-	3	-	-	-	14
2.	BS	12	4	4	4	-	-	-	-	24
3.	ES	6	13	6	3	-	-	-	-	28
4.	PC	-	3	10	16	13	16	11	-	69
5.	PE	-	-	-	-	3	6	6	6	21
6.	OE	-	-	-	-	-	-	3	3	6
7.	EEC	-	-	-	-	4	-	5	10	19
	Total	22	24	23	23	23	22	25	19	181
8.	Non Credit / Mandatory									

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FOUNDATIONAL ENGLISH **L T P C**
4 0 0 4
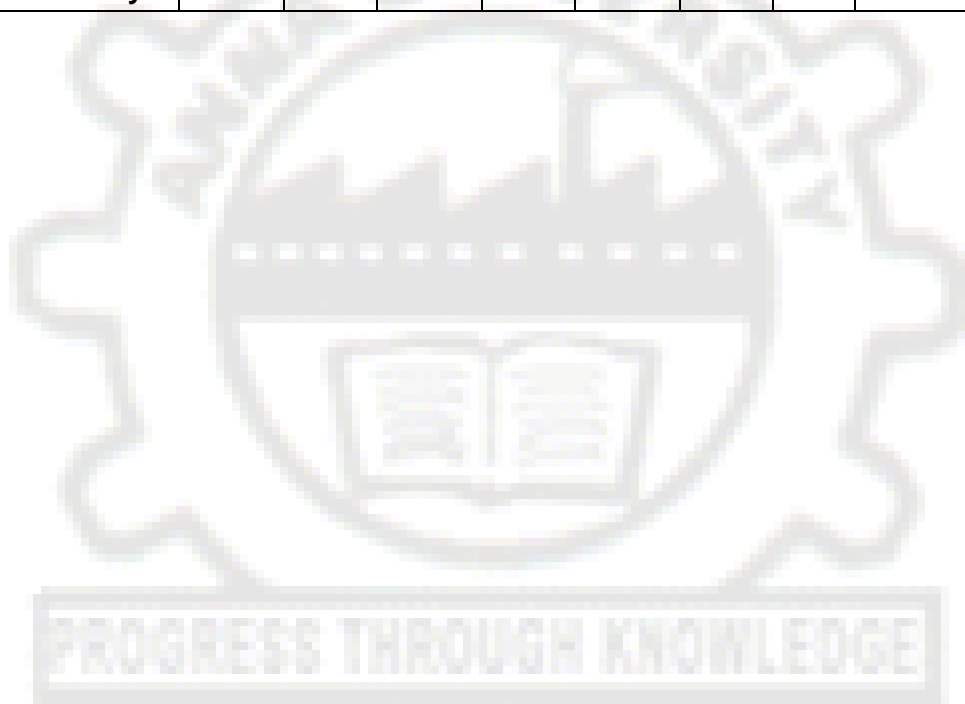
COURSE DESCRIPTION:
This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:
- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS:
UNIT I   GREETING AND INTRODUCING ONESELF   12
Listening- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; **Reading** – Skimming a passage– Scanning for specific information; **Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II   GIVING INSTRUCTIONS AND DIRECTIONS   12
Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description(non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion (root words).

UNIT III   READING AND UNDERSTANDING VISUAL MATERIAL   12
Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material; **Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

UNIT IV   CRITICAL READING AND WRITING   12
Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference);**Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V   LETTER WRITING AND SENDING E-MAILS   12
Listening- Listening to programmes/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading**–Extensive reading; **Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

TEACHING METHODS:
Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL: 60 PERIODS

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OUTCOMES:
- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

TEXTBOOK:
1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange: English for International Communication. (level2, Student's Book)** Cambridge University Press, New Delhi: 2010.

REFERENCES:
1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge, 2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively: Developing Speaking Skills for Business English.** Cambridge University Press, Cambridge: Reprint 2011.

MA7151	MATHEMATICS – I	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes in I Semester)	4	0	0	4

OBJECTIVES:
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I   DIFFERENTIAL CALCULUS   12
Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II   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.

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UNIT III   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 IV   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.

UNIT V   DIFFERENTIAL EQUATIONS   12

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

TOTAL: 60 PERIODS

OUTCOMES:
- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXTBOOKS:
1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES:
1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

Attested

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PH7151   **ENGINEERING PHYSICS**   **L T P C**
                  (Common to all branches of B.E / B.Tech programmes)   **3 0 0 3**

OBJECTIVE:
- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I   PROPERTIES OF MATTER   9
Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II   ACOUSTICS AND ULTRASONICS   9
Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focusing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

UNIT III   THERMAL AND MODERN PHYSICS   9
Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

UNIT IV   APPLIED OPTICS   9
Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser - semiconductor lasers: homo junction and hero junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V   CRYSTAL PHYSICS   9
Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, detections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

                                                                TOTAL: 45 PERIODS

Attested

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OUTCOME:

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TEXT BOOKS:
1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
2. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:
1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. 2010.
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, 2007.
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. 2007.

CY7151	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

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.

UNIT II   SURFACE CHEMISTRYAND CATALYSIS   9
Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-Types of isotherms – Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis - Menton equation. Industrial applications of catalysts.

UNIT III   PHOTOCHEMISTRY AND SPECTROSCOPY   9
Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence09 and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

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UNIT IV   CHEMICAL THERMODYNAMICS   9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtz and Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

UNIT V   NANOCHEMISTRY   9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles – sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL: 45 PERIODS

OUTCOMES:
- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

TEXT BOOKS:
1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company   Pvt. Ltd. Chennai, 2014

REFERENCES:
1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

GE7152	ENGINEERING GRAPHICS	L	T	P	C
		3	2	0	4

OBJECTIVES
• To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)   1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

14

UNIT I PLANE CURVES AND FREE HANDSKETCHING

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES　　　14

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS　　　14

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF
　　　　　　　SURFACES　　　14

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS　　　15

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems.
Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY)　　　3

Introduction to drafting packages and demonstration of their use.

L=45+T=30, TOTAL: 75 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, planes and solids
- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

TEXT BOOK:
1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES:
1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,'' Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production",Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2008.

5. K. V.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015.

Publication of Bureau of Indian Standards:
1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be Permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

BS7161	BASIC SCIENCES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	0	0	4	2

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, band gap determination and viscosity of liquids.

PHYSICS LABORATORY: (Any Seven Experiments)
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
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille"s flow

TOTAL: 30 PERIODS

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

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

1. Estimation of HCl using Na_2CO_3 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 poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 30 PERIODS

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

GE7162	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all Branches of B.E. / B.Tech. Programmes)	0	0	4	2

OBJECTIVES

• To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES   **15**

PLUMBING

Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
• Laying pipe connection to the suction side of a pump.
• Laying pipe connection to the delivery side of a pump.
• Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

• Sawing, planning and making joints like T-Joint, Mortise and Tenon joint and Dovetail Joint.

STUDY

• Study of joints in door panels and wooden furniture
• Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICES   15
 • Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
 • Stair case light wiring
 • Tube – light wiring
• Preparation of wiring diagrams for a given situation.
• Study of Iron-Box, Fan Regulator and Emergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS)   15
3. MECHANICAL ENGINEERING PRACTICES

WELDING
 • Arc welding of Butt Joints, Lap Joints, and Tee Joints
 • Gas welding Practice.
 • Basic Machining - Simple turning, drilling and tapping operations.
 • Study and assembling of the following:
        a. Centrifugal pump
        b. Mixie
        c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.
4. ELECTRONIC ENGINEERING PRACTICES   15
 • Soldering simple electronic circuits and checking continuity.
 • Assembling electronic components on a small PCB and Testing.
 • Study of Telephone, FM radio and Low Voltage Power supplies.

                                                             TOTAL: 60 PERIODS

OUTCOMES:
 • Ability to fabricate carpentry components and to lay pipe connections including plumbing
   Works.
 • Ability to use welding equipments to join the structures
 • Ability to do wiring for electrical connections and to fabricate electronics circuits.

HS7251   **TECHNICAL ENGLISH**   **L T P C**
                                                                        4 0 0 4
OBJECTIVES:
 • To enable students acquire proficiency in technical communication.
 • To enhance their reading and writing skills in a technical context.
 • To teach various languages learning strategies needed in a professional environment.

CONTENTS:
UNIT I   ANALYTICAL READING   12
Listening- Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing)-explaining how something works-describing technical functions and applications; **Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

UNIT II   SUMMARISING   12
Listening- Listening to lectures/ talks on Science &Technology; **Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing**- Extended definition –Lab Reports – Summary writing.

UNIT III   DESCRIBING VISUAL MATERIAL   12
Listening- Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** – Reading journal articles - Speed reading; **Writing**-data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

UNIT IV WRITING/ E-MAILING THE JOB APPLICATION 12
Listening- Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice (mock interview); **Reading** – Reading job advertisements and profile of the company concerned; **Writing**- job application – cover letter –Résumé preparation.

UNIT V REPORT WRITING 12
Listening- Viewing a model group discussion; **Speaking** –Participating in a discussion - Presentation; **Reading**– Case study - analyse -evaluate – arrive at a solution; **Writing**– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

TEACHING METHODS:
Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.
Interactive sessions.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL: 60 PERIODS

OUTCOMES:
- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

TEXT BOOK:
1. Craig, Thaine**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012

REFERENCES:
1. Laws, Anne. **Presentations.** Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engineering**. Cambridge University Press, Cambridge,New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London: 2004
6. Hewings, Martin**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

MA7251   **MATHEMATICS – II**   **L   T   P   C**
                 (Common to all branches of   B.E. / B.Tech. Programmes   4   0   0   4
                                          in II Semester)

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of the electric current.
- To make the student 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   MATRICES   12
Eigen values 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   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, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III   ANALYTIC FUNCTION   12
Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by

Functions $w = z + c,\ az,\ \dfrac{1}{z},\ z^2$ - Bilinear transformation.

UNIT IV   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.

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UNIT V   LAPLACE TRANSFORMS

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

OUTCOMES:

Upon successful completion of the course, students should be able to:
- Evaluate real and complex integrals using the Cauchy integral formula and the residue Theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXT BOOKS:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES:
1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

BM7201   **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 Tissue: Types – Specialized tissues – functions, Types of glands.

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UNIT II   SKELETAL AND RESPIRATORY SYSTEM   9

Skeletal system: Bone types and functions – Joint - Types of Joint - Cartilage and functions Respiratory System: Components of respiratory system – Respiratory Mechanism. Types of respiration - Oxygen and carbon dioxide transport and acid base regulation.

UNIT III   CIRCULATORY 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 – ECG - Heart sound - Volume and pressure changes and regulation of heart rate –Coronary Circulation. Factors regulating Blood flow.

UNIT IV   URINARY AND SPECIAL SENSORY SYSTEM   9

Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base regulation – Urinary reflex – Homeostasis and blood pressure regulation by urinary system. Special senses: Eye and Ear.

UNIT V   NERVOUS SYSTEM   9

Structure of a Neuron – Types of Neuron. Synapses and types. Conduction of action potential in neuron Brain – Divisions of brain lobes - Cortical localizations and functions - EEG. Spinal cord – Tracts of spinal cord - Reflex mechanism – Types of reflex. Autonomic nervous system and its functions.

TOTAL: 45 PERIODS

OUTCOMES:
The student will have knowledge to:
- Describe basic structural and functional elements of human body.
- Explain organs and structures involving in system formation and functions.
- Identify all systems in the human body.

TEXT BOOKS:
1. Elaine.N. Marieb,"Essential of Human Anatomy and Physiology", Eight edition, Pearson Education NewDelhi, 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, 22nd edition, Mc Graw Hill New Delhi,
2. Eldra Pearl Solomon. "Introduction to Human Anatomy and Physiology", W.B.Saunders Company, 2003.
3. Arthur C. Guyton, "Text book of Medical Physiology", 11th Edition, Elsevier Saunders, 2006

EC7252	ELECTRON 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,– Display devices- LED, Laser diodes, Zener diode-characteristics-Zener Reverse characteristics – Zener as regulator

Attested

UNIT II   TRANSISTORS   9
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor 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 cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V   FEEDBACK AMPLIFIERS AND OSCILLATORS   9
Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:
- Explain the structure of basic electronic devices.
- Design applications using basic electronic devices.

TEXT BOOKS:
1. David A. Bell ,"Electronic Devices and Circuits", Prentice Hall of India, 2004.
2. Sedra and Smith, "Microelectronic circuits "Oxford University Press, 2004.

REFERENCES:
1. Muhammad H. Rashid, "Microelectronic Circuits: Analysis and Design" Cengage Learning, 2009.
2. Thomas L. Floyd, "Electronic devices" Prentice Hall, 2011.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata Mc Graw Hill, 3rd Edition 2003.
4. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

GE7151	COMPUTING TECHNIQUES	L	T	P	C
	(Common to all branches of Engineering and Technology)	3	0	0	3

OBJECTIVES:
- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I   INTRODUCTION   9
Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II   C PROGRAMMING BASICS   9
Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

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UNIT III   ARRAYS AND STRINGS   9
Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings-
String operations – String Arrays - simple programs- sorting- searching – matrix operations.

UNIT IV   POINTERS   9
Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems
- Basic file operations.

UNIT V   FUNCTIONS AND USER DEFINED DATA TYPES   9
Function – definition of function – Declaration of function – Pass by value – Pass by reference –
Recursion –Enumerators – Structures – Unions

TOTAL :45 PERIODS

OUTCOMES
At the end of the course, the student should be able to:
- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.

TEXTBOOKS:
1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES:
1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata Mc Graw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

EC7251   **CIRCUIT THEORY**   **L T P C**
                                                                                2 2 0 3
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   6+6
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   4+4
Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent
Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duals, Dual circuits.

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UNIT III   SINUSOIDAL STEADY STATE ANALYSIS   8+8

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   6+6

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   6+6

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: 30 +30 : 60 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Develop the capacity to analyze electrical circuits, apply the circuit theorems in real time
- Design and understand and evaluate the AC and DC circuits.

TEXT BOOKS:
1. William H.Hayt, Jr.Jack E. Kemmerly, Steven M.Durbin, "Engineering Circuit Analysis", Sixth Edition, Tata Mc Graw-Hill Edition, 2012.
2. David A Bell, "Electric Circuits", PHI,2006.

REFERENCES:
1. Charles K. Alexander & Mathew N.O.Sadiku, Fundamentals of Electric Circuits", Second Edition, Mc Graw- Hill 2003.
2. D.R.Cunningham, J.A.Stuller, "Basic Circuit Analysis", Jaico Publishing House, 2005

EC7261	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

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10. Design and Analysis of Feedback Amplifiers
11. Design and Analysis of Differential Amplifier
12. Design of RC Oscillators and LC Oscillators

TOTAL: 60 PERIODS

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

GE7161	**COMPUTER PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:
- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

LIST OF EXPERIMENTS
1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function
10. Program using structures and unions.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Write and compile programs using C programs.
- Write program with the concept of Structured Programming
- Identify suitable data structure for solving a problem
- Demonstrate the use of conditional statement.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS
30 Systems with C compiler

BM7301   **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 - Hasselbalch 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 aminoacids. 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
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Explain about bio molecules such as Carbohydrates, Lipids, Nucleic Acid & Protein and its functions
- Assess the significance of bio molecules in biological systems.
- 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.

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REFERENCES:
1. Trevor palmer"Understanding Enzymes", Ellis Horwood LTD, 4rd Edition, 1995.
2. Pamela.C.Champe and Richard. A. Harvey "Biochemistry Lippincott"s Illustrated Reviews".
   Lippincott-Raven publishers, 6th Edition, 2013.

BM7302	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 PIEZO ELECTRIC 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

OUTCOMES:
Upon completion of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Describe the purpose and methods of measurements
- Analyze the characteristics of different transducers
- Explain different display and recording devices for various applications.

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TEXT BOOKS:

1. L.A Geddes and L.E.Baker , 'Principles of Applied Biomedical Instrumentation' Third Edition, – John Wiley and sons, Reprint 2008.
2. 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",10th Edition, Dhanpat Rai&Co,New Delhi,2000.
2. Ernest o Doebelin and dhanesh N manik, Measuremet systems, Application and design, 5th Edition, Mc Graw-Hill, 2007.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill,   New Delhi, 3rd Edition, 2014.
4. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd. , New Delhi, 2nd Edition, Reprint, 2013.
1. John G.Webster, 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, 2009.

EC7355   **SIGNALS AND SYSTEMS**   **L T P C**
                                                                                                                 2 2 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 visualization and mathematical representation of continuous-time and discrete-time signals
- To teach the applications of Laplace and Fourier transforms in the analysis of continuous-time signals
- To teach the applications of Z- and Fourier transforms in the analysis of discrete – time signals

UNIT I   CLASSIFICATION OF SIGNALS AND SYSTEMS   6+6

Continuous time signals (CT signals)- Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential - classification of CT and DT signals – periodic and a periodic signals, random signals, Energy & Power signals - CT systems and DT systems, Classification of systems.

UNIT II   ANALYSIS OF CONTINUOUS TIME SIGNALS   6+6

Fourier series analysis- Spectrum of Continuous Time (CT) signals- Fourier and Laplace transforms in Signal Analysis.

UNIT III   LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS   6+6

Differential Equation-Block diagram representation-impulse response, convolution integrals-Fourier and Laplace transforms in Analysis.

UNIT IV   ANALYSIS OF DISCRETE TIME SIGNALS   6+6

Baseband Sampling of CT signals- Aliasing, Reconstruction of CT signal from DT signal DTFT and properties, Z-transform & properties.

UNIT V   LINEAR TIME INVARIANT –DISCRETE TIME SYSTEMS   6+6

Difference Equations-Block diagram representation-Impulse response-Convolution sum-DTFT and Z Transform analysis of Recursive & Non-Recursive systems.

TOTAL: 30L + 30T: 60 PERIODS

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OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- To compute the spectrum of any signal
- To identify the requirements and use transforms for processing real-world signals
- To analyse and design continuous-time and discrete-time systems

TEXT BOOKS:
1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2007.
2. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, Second Edition, 2009.

REFERENCES:
1. H P Hsu, "Signals and Systems", Schaum's Outlines, Tata McGraw Hill,2006
2. S. Haykin and B. Van Veen, "Signals and Systems", Second Edition, Wiley, 2003.
3. P.Ramakrishna Rao, "Signals and Systems" , Tata Mc Graw Hill Publications, 2008.
4. Edward W. Kamen, Bonnie S. Heck, "Fundamentals of Signals and Systems Using the Web and MATLAB", Pearson, Indian Reprint, 2007
5. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007
6. M.J.Roberts, "Signals & Systems, Analysis using Transform methods & MATLAB", Tata McGraw Hill (India), 2007.

EE7305   **ELECTRICAL ENGINEERING**   **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 magnetic circuits, principle and application of transformers
- To know the Principle of operation of DC motors and AC Machines

UNIT I   INDUCTION THEORY   9
Magnetic effects of electric current- Magnetic circuits- Magnetic materials and B-H relationship-Energy and co energy– Electromagnetic induction and force – Hysteresis and eddy current losses

UNIT II   TRANSFORMER   9
Introduction – Single phase transformer construction and principle of operation – EMF equation of transformer-Transformer no–load phasor diagram –– Transformer on–load phasor diagram –– Equivalent circuit of transformer – Regulation of transformer –Transformer losses and efficiency-All day efficiency –auto transformers.

UNIT III   DC MACHINES   9
Construction of DC machines – theory of operation of DC generators- EMF and torque equations–characteristics of DC generators-Applications. Operating principle of DC motors –types of DC motors and their characteristics – speed control of DC motors-Applications, Stepper motor and Applications.

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UNIT IV   INDUCTION MACHINES AND SYNCHRONOUS MACHINES   9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit –Construction of single-phase induction motors – Double revolving field theory – starting methods Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

UNIT V   SPECIAL ELECTRIC MACHINES   9

Switched reluctance motor, stepper motor, servo motor, BL DC motor- working principles, speed-torque characteristics and applications.

OUTCOMES:
At the end of the course, the student should be able to:
* Comprehend and appreciate the significance and role of this course in the present contemporary world
* Describe principles and applications of transformers.
* Explain the working of DC Motors, fractional kW motors, AC machines.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", TMH, 2ed, 2002
2. P. C Sen, "Principles of Electric machines and power electronics", John- Wiley & Sons, 2ndedition, 2007.

REFERENCES:
1. Stephen J. Chapman, " Electric Machinery fundamentals", " Mc Graw Hill Intl. Edition, New Delhi, Fourth Edition, 2005.
2. Fitzgerald, A.E.Charles Kingsley Jr.Stephen D. Umans, " Electric Machinery", Mc Graw Hill Book Compny, sixth Edition 2003.
3. T. Kenjo and S.Nagomari, "Permanent magnet and brushless DC motors, Clarendon 125 Press, London, 1988.

GE7251   ENVIRONMENTAL SCIENCE AND ENGINEERING   L T P C
3 0 0 3

OBJECTIVES:
* To the study of nature and the facts about environment.
* To find and implement scientific, technological, economic and political solutions to environmental problems.
* To study the interrelationship between living organism and environment.
* To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
* To study the dynamic processes and understand the features of the earth's interior and surface.
* To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

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 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 Production 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

OUTCOMES:
Upon successful completion of the course, students will be able to:
Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:
1. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Second Edition, Pearson Education 2004.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, 2006.

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 Publishing, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice Hall, 2007.
4. Rajagopalan.R, "Environmental Studies-From Crisis to Cure", Oxford University Press 2005.

MA7358	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIA L EQUATIONS	L T P C 4 0 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 apart from its use in solving boundary value problems;
- 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 – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Classification of partial differential equations - 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
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.

TOTAL: 60 PERIODS

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OUTCOME:
- The students can able to solve the partial differential equations, find the Fourier series analysis and solve the problems by using Fourier transform and Z transform techniques.

TEXTBOOKS:
1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, New Delhi, 2014

REFERENCES:
1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 11th Reprint , 2010.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

BM7311	BIOCHEMISTRY AND HUMAN PHYSIOLOGY 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 provide practice on
- Estimation and quantification of bio molecules.
- 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"s and Rinne "s test for auditory conduction.

TOTAL: 60 PERIODS

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OUTCOMES:
Upon completion of the course, students will be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
- Separate and analyze the importance of macromolecules.
- Discuss the various blood parameters in pathological conditions.
- Analyze, interpret and report the results of the laboratory experiments.
- Implement experimental protocols and adopt to plan and carry out simple investigations.

BM7312   **SENSORS AND MEASUREMENTS 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 the characteristics of sensors, signal conditioning circuits and display devices

LIST OF EXPERIMENTS:
1. Characteristics of strain guages.
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, PhotoDiode, 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. Study of Medical Oscilloscope.
12. Study of Input / Output characteristics using X – Y oscilloscope.

TOTAL: 60 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Students are able to design a measurement system for various applications

BM7401   **ANALOG AND DIGITAL COMMUNICATION**   **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 various analog and digital modulation techniques

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- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I   ANALOG MODULATION   9
Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

UNITII   PULSE MODULATION   9
Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

UNIT III   DIGITAL MODULATION AND TRANSMISSION   9
Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

UNIT IV   INFORMATION THEORY AND CODING   9
Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

UNIT V   SPREAD SPECTRUM AND MULTIPLE ACCESS   9
PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

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

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

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BIOMEDICAL INSTRUMENTATION AND MEASUREMENTS **L T P C**
                                                                                        3 0 0 3

OBJECTIVES:
The student should be made 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
- Study the basic theory of Bio potential Electrodes and Bio potential measurement.
- Understand the design of Bio potential amplifiers.
- Study the various non-electrical physiological 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 – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

UNIT II   BIOPOTENTIAL MEASUREMENT   9
Biosignal characteristics– frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram.

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. Power line interference.

UNIT IV   NON ELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT   10
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement, Measurements of heart sounds - PCG.

UNIT V   BIOCHEMICAL MEASUREMENT   9
Biochemical sensors - pH, Po2 and Pco2, 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 (simplified schematic description).

                                                                        TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Describe the fundamentals of Bio potential recording.
- Design various bio amplifiers.
- Measure various physiological and bio chemical parameters.

TEXT BOOKS:
1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th edition, 2008.
2. John G.Webster, 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, 2009

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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, Reprint 2008
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd. , New Delhi, 2nd Edition, Reprint, 2013.
4. Myer Kutz 'Standard Handbook of Biomedical Engineering & Design' – McGraw-Hill Publisher, 2003.

BM7403   **CONTROL SYSTEM FOR BIO MEDICAL ENGINEERING**   **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 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

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   TIME RESPONSE 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.

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.

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OUTCOMES:

The students will be able to:

- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Develop mathematical model and perform stability analysis.
- Analyze the different systems in time and frequency domain.
- Explain the concept of physiological control systems

TEXT BOOKS:

1. J.Nagrath and M.Gopal," Control System Engineering", New Age International Publishers, 5th Edition, 2007.
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 2009.
2. M.Gopal, "Control System – Principles and Design", Mc Graw-Hill, 2nd edition 2006.
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.

EC7353	DIGITAL ELECTRONICS AND SYSTEM DESIGN	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 Boolean algebra and its applications in digital systems
- 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
- To introduce the electronic circuits involved in the making of logic gates
- To introduce semiconductor memories and related technology

UNIT I   BASIC CONCEPTS AND COMBINATIONAL 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.

UNIT II   MSI CIRCUITS   9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry lookahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital transreciver / 8 bit Arithmetic and logic unit

UNIT III   SYNCRONOUS SEQUENTIAL CIRCUITS   9
Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

UNIT III   ASYNHRONOUS SEQUENTIAL CIRCUITS   9
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V   LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES   9
Logic families- TTL, MOS, CMOS, BiCMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, ROM, PLA and PAL.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Use Boolean algebra and apply it to digital systems.
- Design various combinational digital circuits using logic gates.
- Bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.
- Use electronic circuits involved in the design of logic gates.
- Ability to use the semiconductor memories and related technology.

TEXT BOOKS:
1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2013.
2. Charles H. Roth, Jr, "Fundamentals of Logic Design", Fourth edition, Jaico Books, 2002.

REFERENCES:
1. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
2. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
3. John. F. Wakerly, "Digital design principles and practices", Pearson Education, Fourth Edition, 2007.

EC7452   OPERATIONAL AMPLIFIERS AND ANALOG INTEGRATED CIRCUITS   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 circuit configuration of linear integrated circuits.
- To introduce practical applications of linear integrated circuits.
- To introduce the concept of analog multiplier and Phase Locked Loop with applications.
- To study the application of ADC and DAC in real time systems.
- To introduce special function ICs and its construction.

UNIT I   CIRCUIT CONFIGURATION FOR LINEAR ICS   9
Current sources, Analysis of difference amplifiers with active loads, supply and temperature independent biasing, Band gap references, Monolithic IC operational amplifiers, specifications, frequency compensation, slew rate and methods of improving slew rate. Interpretation of TL082 datasheet.

UNIT II APPLICATION OF OPERATIONAL AMPLIFIERS 9

Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Noninverting Amplifiers, Differentiator, Integrator, Voltage to Currency converter, Instrumentation amplifier, Sine wave Oscillators, Low pass and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analysis of four quadrants and variable Transconductance multipliers, Analog multiplier MPY634 features, Voltage controlled oscillator, Closed loop analysis of PLL, AM, PM and FSK modulators and demodulators, AVC using op-AMP, Frequency synthesizers, Compander ICs.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTORS 9

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter, Current driven DAC, Switches for DAC, A/D converter - Flash, Single slope, Dual slope, Successive approximation, DM and ADM, Voltage to Time and Voltage to Frequency converters.

UNIT V SPECIAL FUNCTION ICS 9

Timers, Voltage regulators - linear and switched mode types, Switched capacitor filter, SMPS, Features of TPS40200, TPS40210 buck and boost controller, Frequency to Voltage converters, Tuned amplifiers, Power amplifiers and Isolation Amplifiers, Video amplifiers, Fiber optics ICs and Opto couplers, Sources for Noises, Op Amp noise analysis and Low noise OP-Amps.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to design new analog linear circuits
- Ability to analyze and develop linear IC based Systems.
- Ability to select appropriate IC's and circuit for analog system design.

TEXT BOOK:
1. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw Hill Education, 2014.

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, 1996.
3. Ramakant A. Gayakwad, " OP - AMP and Linear IC's ", Prentice Hall, 2012.
4. Botkar K.R., "Integrated Circuits", Khanna Publishers, 1996.
5. Taub and Schilling, "Digital Integrated Electronics ", McGraw Hill, 1977.
6. Caughlier and Driscoll, "Operational amplifiers and Linear Integrated circuits ", Prentice Hall, 1989.
7. Millman J. and Halkias C., "Integrated Electronics ", McGraw Hill, 2001.

MA7356 **PROBABILITY AND RANDOM PROCESSES** **L T P C**
4 0 0 4

OBJECTIVES:
- To provide the necessary basic concepts in probability and random processes and apply them in random signals, linear systems etc. in communications engineering.
- The students will have an exposure of various distributions.

UNIT I   RANDOM VARIABLES   12

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions
- Functions of a random variable.

UNIT II   TWO-DIMENSIONAL RANDOM VARIABLES   12

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III   RANDOM PROCESSES   12

Classification – Stationary process – Markov process - Poisson process – Random telegraph process.

UNIT IV   CORRELATION AND SPECTRAL DENSITIES   12

Auto-correlation functions – Cross-correlation functions – Properties – Power spectral density– Cross-spectral density – Properties.

UNIT V   LINEAR SYSTEMS WITH RANDOM INPUTS   12

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto-correlation and Cross-correlation functions of input and output – White noise.

TOTAL: 60 PERIODS

OUTCOMES:
- The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS:
1. Ibe, O.C. "Fundamentals of Applied Probability and Random Processes", Elsevier, U.P., 1st Indian Reprint, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, New Delhi, 4 th Edition, 2002.

REFERENCES:
1. Yates, R.D. and Goodman, D.J., "Probability and Stochastic Processes", John Wiley and Sons, 2nd Edition, 2005.
2. Miller, S. L. and Childers, D. G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
3. Hwei Hsu, "Schaum"s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill, New Delhi, 9th reprint,2010.

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BM7411   **BIO MEDICAL INSTRUMENTATION 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 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.
3. Design of EMG amplifier.
4. Measurement of heart sounds using PCG.
5. Study of effect of offset potential in Bio potential recording.
6. Study of effect of contact impedance in Bio potential recording.
7. Measurement of pulse-rate using Photo transducer.
8. Measurement of respiration rate.
9. Measurement of blood flow velocity using ultrasound transducer.
10. Measurement of heart rate using F-V converter.
11. Measurement of blood pressure using sphygmomanometer.
12. Study of characteristics of optical Isolation amplifiers.

TOTAL: 60 PERIODS.

OUTCOMES:
Students are able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Design the amplifier for Bio signal measurements
- Record and analyse physiological parameters

BM7412   **DIGITAL AND INTEGRATED CIRCUITS 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 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. Active filter – first order and second order LPF and HPF
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier using operational amplifier
6. RC and LC oscillators
7. Multivibrators using IC555 Timer

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8. Study of logic gates, Half adder and Full adder
9. Encoder and BCD to 7 segment decoder
10. Multiplexer and demultiplexer using digital ICs
11. Universal shift register using flipflops
12. Design of mod-N counter

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Design Circuits using logic gates
- Design and implement circuits for different applications using opamp
- Design oscillators and wave form generators

BM7501   DIAGNOSTIC AND THERAPEUTIC EQUIPMENT - I   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 medical devices applied in measurement of parameters related to cardiology, neurology and the methods of continuous monitoring and transmitting them.
- To learn some of the cardiac assist devices.
- To learn to measure the signals generated by muscles.
- To understand the need and use of some of the extracorporeal devices.

UNIT I   CARDIAC EQUIPMENT   9
Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, Plethysmography. Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External.

UNIT II   NEUROLOGICAL EQUIPMENT   9
Multi channel EEG recording system, Clinical significance of EEG- Epilepsy, Evoked Potential – Visual, Auditory and Somatosensory, EEG Bio Feedback Instrumentation, MEG (Magneto Encephalo Graph) -sensing principle and instrumentation (Block diagram)

UNIT III   SKELETAL MUSCULAR EQUIPMENT   9
Generation of EMG, recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation.

UNIT IV   PATIENT MONITORING AND BIOTELEMETRY   9
Patient monitoring systems, ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

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, electronic monitoring of functional parameters. Hemo Dialyser unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laparoscopy. Thermography – Recording and clinical application.

TOTAL: 45 PERIODS

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OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply different medical devices in the measurement of parameters related to cardiology, neurology
- Explain about cardiac assist devices, its continuous monitoring and transmission
- Measure and analyse signals generated by muscles

TEXT BOOKS:
1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th edition, 2008.
2. John G.Webster, 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, 2009.

REFERENCES:
1. Kutz, "Standard Handbook of Biomedical Engineering & Design", McGrawHill, New York, 2003.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, Reprint 2008
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd. , New Delhi, 2nd Edition, Reprint, 2013.
4. Antony Y.K.Chan," Biomedical Device technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008

BM7502	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 – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management

UNIT II   HUMAN RESOURCE MANAGEMENT ON 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.

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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.

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

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Explain the principles, practices and areas of application in Hospital Management

TEXT BOOKS:
1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI –Fourth Edition, 2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth 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",2ndedition (1990) - Aspen Publication Inc. Rockville, Maryland, USA
3. Peter Berman "Health Sector Reform in Developing Countries" - Harvard University Press,
4. 1995.
5. William A. Reinke "Health Planning For Effective Management" - Oxford University Press.
6. Health and Social organization: Towards a health policy for the 21st century – Blane, David, Brunner, Eric – Calrendon Press
7. Health Care Management - Arnold D. Kalcizony & Stephen M. Shortell

EC7352	DATA STRUCTURES AND OBJECT ORIENTED PROGRAMMING IN C++	L T P C 3 2 0 4

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 comprehends the fundamentals of object oriented programming, particularly in C++, which are then used to implement data structures. This also gives an idea of linear and non-linear data structures and their applications.

UNIT I   DATA ABSTRACTION & OVERLOADING   9+6

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading.

UNIT II   INHERITANCE & POLYMORPHISM   9+6

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

UNIT III   LINEAR DATA STRUCTURES   11+6

Asymptotic Notations: Big-Oh, Omega and Theta – Best, Worst and Average case Analysis: Definition and an example – Arrays and its representations – Stacks and Queues – Linked lists – Linked list based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

UNIT IV   NON-LINEAR DATA STRUCTURES   9+6

Trees – Binary Trees – Binary tree representation and traversals – Threaded binary trees – Binary tree representation of trees – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Connected components.

UNIT V   SORTING & SEARCHING   7+6

Insertion sort – Merge sort – Quick sort – Heap sort – Linear Search – Binary Search.

TOTAL: 45 L+30 T = 75 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Select suitable data structure for specific Application.
- Compare Linear and nonlinear data structures for different application.
- Perform different searching and sorting techniques.
- Identify connected components in trees.
- Analyze asymptotic notations

TEXT BOOKS:
1. Deitel and Deitel, " C++, How To Program", Fifth Edition, Pearson Education, 2005.
2. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, Fundamentals of Data Structures in C++, Galgotia, New Delhi, 1995.

REFERENCES:
1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Third Edition, Addison-Wesley, 2007.
2. Bhushan Trivedi, "Programming with ANSI C++, A Step-By-Step approach", Oxford University Press, 2010.
3. Goodrich, Michael T., Roberto Tamassia, "David Mount. Data Structures and Algorithms in C++", 7th ed, Wiley. 2004.

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EC7451   **MICROPROCESSOR AND 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 study the architecture of 8085, 8086 and 8051
- To study the addressing modes and instruction set of 8085, 8086 and 8051
- To introduce the need and use of interrupt structure in 8085 and 8051.
- To develop skill in simple program writing for 8085 and 8051 applications.
- To introduce commonly used peripheral / interfacing ICs.

UNIT I   8- BIT MICROPROCESSOR.   9
8085 Architecture, Pin configuration, Instruction set, Addressing modes, Interrupts, Timing diagrams Memory and I/O interfacing.

UNIT II   16- BIT MICROPROCESSOR.   9
8086 Architecture, Instruction set, Addressing modes, Minimum and Maximum mode configuration, Assembler Directives, Assembly Language Programming, Interrupts. Features of 80186, 80286, 80386, and 80486.

UNIT III   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 IV   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 V   MICROCONTROLLER BASED SYSTEM DESIGN.   9
Interfacing to: matrix display, (16x2) LCD, high power devices, optical motor shaft encoder, Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol.

                                                            TOTAL: 45 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to design and develop microprocessor architecture.
- Ability to develop microprocessor and microcontroller systems for entertainment, communication and medical applications.
- Ability to troubleshoot microprocessor and microcontroller systems.

TEXT BOOKS:
1. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085". Sixth edition, Penram International Publishing 2012.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware". Revised Second Edition 2006, eleventh reprint 2010.Tata McGraw Hill.

REFERENCES:
1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", Second Edition, Pearson Education 2008. Fifth impression 2011.
2. Krishna Kant, " Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051 and 8096, PHI, 2007, Seventh Reprint, 2011.
3 Kenneth J. Ayala., "The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning, 2012.
4. A.K. Ray, K.M. Bhurchandi, "Advanced Microprocessor and Peripherals", Second edition, Tata Mc Graw-Hill, 2010.
5. Barry B. Brey, "The Intel Microprocessors Architecture, Programming and Interfacing", Pearson Education, 2007. Second impression 2010.

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EC7552   **DISCRETE TIME SIGNAL PROCESSING**   **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 computation of spectrum and to analyze systems
- To understand filters for spectrum shaping
- To understand implementation issues in a Digital Signal Processor

UNIT I   DISCRETE FOURIER TRANSFORM   9
Review of discrete-time signals & systems - DFT and its properties, FFT algorithms & its applications, Overlap-add & overlap-save methods.

UNIT II   DESIGN OF INFINITE IMPULSE RESPONSE FILTERS   9
Analog filters – Butterworth filters, Chebyshev Type I filters (upto 3 rd 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, parallel forms.

UNIT III   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 & IIR.

UNIT IV   FINITE WORDLENGTH FFECTS   9
Representation of numbers-ADC Quantization noise-Coefficient Quantization error, Product Quantization error-truncation & rounding errors -Limit cycle due to product round-off error- Round-off noise power

UNIT V   INTRODUCTION TO DIGITAL SIGNAL PROCESSORS   9
DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

                                                              TOTAL: 45 PERIODS
OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Design systems using spectrum information
- Hardware design and implementation of digital signal processing systems

TEXT BOOKS:
1. John G Proakis and Manolakis, ―Digital Signal Processing Principles, Algorithms and Applications‖, Pearson, Fourth Edition, 2007
2. A.V.Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, 8 th Indian Reprint, Pearson, 2004.

REFERENCES:
1. Steven W. Smith, "Digital Signal Processing – A practical guide for Engineers and Scientist", Newnes publications, 2003
2. I.C.Ifeachor and B.W. Jervis, Digital Signal Processing- A practical approach, Pearson,2002.
3. D.J. De Fatta, J.G.Lucas and W.S. Hodgkiss, Digital Signal Processing- A system Design Approach, John Wiley & sons, Singapore, 1988.
4. M. H. Hayes, Digital Signal Processing, Schaum‛s outlines, Tata McGraw Hill, 2007.
5. Sanjit K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th Edition, Copyright© 2011, The McGraw-Hill Companies, Inc

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BM7511   **MICROCONTROLLER AND 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.

8085 based experiments:
1. Assembly Language Programming of 8085.

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

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

                                                          TOTAL: 60 PERIODS
OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to design and develop microprocessor based system for real time application.
- Ability to develop microprocessor and microcontroller systems for entertainment, communication and medical applications.
- Ability to troubleshoot microprocessor and microcontroller systems.

EC7561   **DISCRETE TIME SIGNAL PROCESSING LABORATORY**   **L T P C**
                                                                       0 0 4 2

OBJECTIVES:
- To implement Linear and Circular Convolution
- To implement FIR and IIR filters
- To study the architecture of DSP processor
- To demonstrate Finite word length effect

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

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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. Decimation and Interpolation

TOTAL: 60 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Carry out simulation of DSP systems
- Demonstrate their abilities towards DSP processor based implementation of DSP systems
- Analyze Finite word length effect on DSP systems
- Demonstrate the applications of FFT to DSP
- Implement adaptive filters for various applications of DSP

BM7601   **BIOMECHANICS**   **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 about the mechanics involved with various physiological systems.
- To gain knowledge in deriving the mathematical models related to blood vessels.

UNIT I   INTRODUCTION   9
Scope of mechanics in medicine, mechanics of bone structure, determination of in-vivo elastic modulus. Biofluid mechanics, flow properties of blood.

UNIT II   MECHANICS OF PHYSIOLOGICAL SYSTEMS   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   ORTHOPAEDIC APPLICATIONS   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.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Explain the mechanics of physiological systems.
- Analyze the biomechanical systems.
- Design orthopedic applications.

TEXT BOOKS:
1. Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1998.
2. C. Ross Ethier 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
5. Engineering" Elsevier,2005
6. B.H.Brown, PV Lawford, RH Small wood,DR Hose, Dc Barber, Medical Physics and
7. Biomedical Engineering – CRC Press, 1999.
8. Dhanjoo N. Ghista, "Bio-mechanics of Medical Devices", Marcel Dekker, 1980.
9. Haufred Clynes, "Bio-medical Engineering Systems", McGraw Hill, 1998.

BM7602   **DIAGNOSTIC AND THERAPEUTIC EQUIPMENT - II**   **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:
- Gain knowledge about measurements of parameters related to respiratory system
- Learn measurement techniques of sensory responses
- Understand different types and uses of diathermy units.
- Know ultrasound imaging technique and its use in diagnosis
- Know the importance of patient safety against electrical hazard

UNIT I   RESPIRATORY MEASUREMENT STSTEM   10
Instrumentation for measuring the mechanics of breathing – Spiro meter-Lung Volume and vital capacity, 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   SENSORY MEASUREMENT   8
Psycho Physiological Measurements-for testing sensory Responses, Electro occulograph, Electro retinograph, Audiometer-Pure tone, Speech. EGG (Electrogastrograph), galvanic skin resistance (GSR), polygraph.

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   ULTRASONIC TECHNIQUE   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.   Electrical safety codes and standards, Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electrical safety of medical equipment.

TOTAL: 45 PERIODS

OUTCOMES:

 At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Explain about measurements of parameters related to respiratory system and sensory responses
- Analyze different types of diathermy units and ultrasound scanner
- Identify the electrical hazards
- Implement methods of patient safety

TEXT BOOKS:
1. Leslie Cromwell, Fred J. Seibel, Erich A. Pfeiffer, "Biomedical Instrumentation and Measurement", Prentice Hall India Pvt. Ltd., New Delhi, 2nd Edition, Reprint, 2013.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th edition, 2008.

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", John Wileyand Sons, Reprint 2008
4. John G.Webster, 'Medical Instrumentation Application and Design', 4th edition, John Wiley and Sons, New York, 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.

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BM7603   **PATHOLOGY AND MICROBIOLOGY**   **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 structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.
- To empower the importance of public health.

UNIT I   CELL DEGENERATION, REPAIR AND NEOPLASIA   9
Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours. Autopsy and biopsy.

UNIT II   FLUID AND HEMODYNAMIC DERRANGEMENTS   9
Edema, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas.

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.

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.

UNIT V   IMMUNOLOGY   9
Natural and artificial immunity, opsonization, phagocytosis, inflammation, Immune deficiency syndrome, antibodies and its types, antigen and antibody reactions, immunological techniques: immunodiffusion, immuno electrophoresis, radioimmunoassay and enzyme linked immune sorbent assay, monoclonal antibodies. Disease caused by bacteria, fungi, protozoal, virus and helminthes.

                                                                TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Analyze structural and functional aspects of living organisms.
- Explain the function of microscopes.
- Discuss on the importance of public health.
- Describe treatment methods involved in curing the pathological diseases.

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 3edn. 2000.
2. Ananthanarayanan, "Microbiology", Panicker University press. 9th edition 2013
3. Dubey RC and Maheswari DK "Microbiology", S Chand Publications 3rd edition 2010
4. Prescott, Harley,Klein, "Microbiology", Mc Graw Hill 9th ed. 2013.

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RADIOLOGICAL EQUIPMENT **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 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, the collimator, Bucky Grid, power supply, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – 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   MAGNETIC RESONANCE 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), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV   NUCLEAR MEDICINE SYSTEM   9
Radio Isotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. 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
Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techiniques in radiation therapy - 3DCRT – IMRT – IGRT and Cyberknife- radiation measuring instruments- Dosimeter, film Badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

TOTAL: 45 PERIODS.

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Describe the different types of medical imaging techniques.
- Explain the principle of Radio therapy techniques.

TEXT BOOKS:
1. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia,1988.
2. R. Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002.

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REFERENCES:
1. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine"- Third edition Springer, 2006.
2. B.H.Brown, PV Lawford, R H Small wood , D R Hose, D C 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.

BM7611	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT 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 provide practice on recording and analysis of different Bio potentials
- 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. Study of Patient Monitoring System
7. Study of biotelemetry
8. Electrical safety measurements.
9. Analysis of characteristics of surgical diathermy.
10. Measurement of Respiratory parameters using spirometry.
11. Measurement of GSR.
12. Recording of Audiogram.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Record and Analyse physiological signal
- Describe the functional characteristics of therapeutic equipment
- Test the safety of medical equipment

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BM7612   **PATHOLOGY AND MICROBIOLOGY 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.
- The student should be made to use Compound microscope
- To practice on chemical examinations, Cryoprocessing, Histopathological examinations   etc

LIST OF EXPERIMENTS:
1. Study of parts of compound microscope & Fluorescent Microscope
2. Histopathological slides of benign and malignant tumours.
3. Manual paraffin tissue processing and section cutting (demonstration)
4. Cryo processing of tissue and cryosectioning (demonstration)
5. Basic staining – Hematoxylin and eosin staining.
6. Viability staining studies using Trypan blue and Fluorescent staining
7. Simple stain.
8. Gram stain.
9. AFB stain.
10. Slides of malarial parasites, micro filaria and leishmania donovani.
11. Haematology slides of anemia and leukemia.
12. Study of bone marrow charts.
13. Bleeding time and clotting time.
14. Sterilization methods demonstration.

                                                                                  TOTAL : 60 PERIODS.
OUTCOMES:
 Students should be capable of
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Using compound microscopes
- Perform practical experiments on tissue processing, cryoprocessing and staining processes.

BM7701   **MEDICAL INFORMATICS**   **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 learn 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 taking by computer, Dialogue with the computer

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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 STORAGE AND AUTOMATION   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 to:
Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Discuss about health informatics and different ICT applications in medicine.
- Explain the function of Hospital Information Systems
- Analyze medical standards

TEXT BOOKS:
1. R.D.Lele, "Computers in medicine progress in medical informatics", Tata McGraw Hill Publishing computers Ltd,2005, New Delhi.
2. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi.

REFERENCES:
1. N.Mathivanan, "PC-Based Instrumentation", Prentice Hall of India Pvt Ltd – New Delhi – 2007.
2. Orpita Bosu and Simminder Kaur Thukral, "Bioinformatics Databases, Tools and Algorithms", Oxford University press, 2007, New Delhi
3. Yi – Ping Phoebe Chen, "Bioinformatics Technologies", Springer International Edition, 2007, New Delhi.

BM7702	PATTERN RECOGNITION AND NEURAL NETWORKS	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 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.

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UNIT I INTRODUCTION AND SUPERVISED LEARNING 9
Overview of Pattern recognition, Relevance to the field, 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, k-means algorithm and Isodata Algorithm, Case studies.

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

UNIT IV BACK PROPAGATION 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

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Explain the fundamentals of pattern recognition and neural networks.
- Design and apply different pattern recognition techniques.

TEXT BOOKS:
1. DudaR.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.

REFERENCES:
1. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002.
2. Freeman J. A., and Skapura B.M, "Neural networks, algorithms, applications and programming techniques", Addison- Wesley, 2003
3. Robert Schalkoff, "Pattern recognition, Statistical, Structural and neural approaches" John Wiley and Sons(Asia) Pvt Ltd., Singapore, 2005.
4. LaureneFausett, "Fundamentals of neural networks- Architectures, algorithms and applications", Prentice Hall, 1994.

EC7751	PRINCIPLES OF DIGITAL IMAGE PROCESSING	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 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 spoilt images
- To introduce schemes for compressing images to save storage space

UNIT I   DIGITAL IMAGE FUNDAMENTALS   9

Elements of digital image processing systems, Vidicon and Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two- dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT, SVD.

UNIT II   IMAGE ENHANCEMENT   9

Point processing, Histograms, Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement.

UNIT III   IMAGE RESTORATION   9

Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations-spatial transformations.

UNIT IV   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 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

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- To utilize appropriate preprocessing techniques for manipulation of images
- To design automated techniques for image based applications

TEXT BOOKS:
1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, Inc., 2002.

REFERENCES:
1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
3. D.E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, "Digital Image Processing" , John Wiley, New York, 2002
5. Milan Sonka et aI, "Image Processing, Analysis and Machine vision", Brookes/Cole, Vikas Publishing House, 2nd edition, 1999
6. Alan C. Bovik, "Handbook of image and video processing" Elsevier Academic press, 2005
7. S.Sridhar, " Digital Image processing" Oxford University press, Edition 2011

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BM7712   **MEDICAL IMAGE PROCESSING 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 the various aspects of image processing techniques for medical images

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

                                                               TOTAL: 60 PERIODS

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

At the end of the course the student will be able to apply analysis and processing techniques to medical images.

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

BM7001   **ADVANCED BIO ANALYTICAL AND THERAPEUTIC TECHNIQUES**   **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 basic preparation of standards.
- To study common analytical techniques.
- To learn the appropriate technique for a given size & type of sample.

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.

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UNIT II   ENZYMES AS A DIAGNOSTIC TOOL   9

Isoenzymes and their significance in diagnosis, enzyme pattern in health and diseased condition –lipase, amylase, ALP, ACP, SGOT, SGPT, LDH & CPK. Techniques in screening isoenzymes. 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 radiodosimetry

UNIT IV   GENE THERAPY   9

Central concept of gene therapy, basic molecular mechanism of gene transfer, human genome project, prerequisite of human gene therapy, biological basis of gene therapy strategies, vehicles for gene transfer, gene transfer methods, clinical gene therapy studies, gene therapy for hereditary disease, gene therapy for cancer, gene therapy for HIV. Ethical issues in human gene therapy.

UNIT V   NANOTHERAPEUTICS   9

Nanoparticles as carriers in drug delivery- design, manufacture and Physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, bone treatment, nano particles for oral vaccination and skin disease. Types of nanoparticles-half life. Fate of nano particles.

TOTAL:45PERIODS

OUTCOMES:
At the end of course, the student should be able to:
* Comprehend and appreciate the significance and role of this course in the present contemporary world
* Report and discuss on chemical analytical aspects relevant for the selection of proper analytical techniques.
* Implement bio analytical aspects in medical sciences.

TEXT BOOKS:
1. Douglas A, "Principles of Instrumental Analysis", SkoogBrooks 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, 4rd edition, 1995
2. Harvey Lodish W. H, "Molecular Cell Biology", Freeman publisher 7th Edition 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", CRCpress 2008.

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BM7002	BIO SIGNAL PROCESSING	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 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

OUTCOMES:
Upon the completion of this course, the students should able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Analyze biosignals in time domain & to estimate the spectrum.
- Apply wavelet detection techniques for biosignal processing.
- 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-Interscience/IEEE Press, 2002.

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., 2002.
3. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000.
4. K.P.Soman,K.IRamachandran,"Insight into wavelet from theory to practice", PHI, New Delhi,2004.
5. JohnL.Semmlow," Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc. New York,2004.
6. KavyanNajarian and Robert Splerstor," Biomedical signals and Image processing", CRC – Taylor and Francis,New York,2006.
7. D.C.Reddy,"Biomedical Signal Processing – Principles and Techniques",TMH,New Delhi, 2005.
8. GariD.Clifford,FranciscoAzuaje and Patrick E.McSharry," Advanced Methods and Tech for ECG Data Analysis", ARTECH House,Boston,2006.

BM7003	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, co-based alloys, Ti-based alloys, ceramic implant materials, aluminum oxides, hydroxyapatite, glass ceramics, carbons, medical applications.

UNIT III   POLYMERIC IMPLANT MATERIALS   9
Polymerization, polyamides, Acryrilic polymers, 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, Intraocular 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, adhesive, 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 (Dialyser membrane), Dental Implants.

TOTAL: 45 PERIODS

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OUTCOMES:
At the end of the course, the student will able to:
- Analyze different types of materials and apply in designing a device.
- Choose materials for design of implants in tissue replacement.

TEXT BOOKS:
1. Sujata V. Bhatt, Biomaterials 7th edition, Narosa Publishing House, 2005.
2. Joon B.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. 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" Volume 14, VCH Publishers 1992
7. BD Ratner, AS Hoffmann,FJ Schoen, JE Lemmons, "An introduction to Materials in Medicine", Academic Press 1996.

BM7004	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   7
Biomaterials: Introduction to biomaterials and requirements of biomaterials, Classification of biomaterials: Metallic, Ceramic, Polymeric and biological biomaterials. Properties of biomaterials: Bulk properties and Surface properties, ethics.

UNIT II   BIOMATERIALS IN MEDICINE   10
Materials for Bone and Joint Replacement: Metals in Joint Replacement: Stainless Steels, 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, drug delivery, ophthalmology and overview of intelligent textiles for medical applications. (examples for each).

UNIT III   PHYSIO-CHEMICAL CHARACTERIZATION   10
Material Characterization: X-ray Diffraction Analysis (XRD), X-ray absorption, -level of exposure and limitations, 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, acoustic and ultrasonic properties.

UNIT IV   SURFACE CHARACTERIZATION   9
Surface properties and adhesion, contact angle measurement, scanning Electron Microscopy (SEM), transmission Electron Microcopy (TEM) and atomic force microscopy (AFM). secondary ion Mass Spectrometry, confocal laser scanning microscopy.

UNIT V   BIOMATERIAL TESTING   9

Biofunctionality and biocompatibility, preservation techniques for biomaterials, in vitro and invivo Assessment of tissue compatibility, testing of blood (HLA typing and blood grouping) –materials, interactions and animal models.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Analyze different types of materials and apply in designing a device.
- Choose materials for design of implants in tissue replacement.

TEXT BOOKS:
1. Sujata V. Bhatt, "Biomaterials" Second Edition, Narosa Publishing House,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.

BM7005   **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

OUTCOMES:
At the end of the course, the student should be able to:
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Demonstrate the principles of biometric systems.
- Design and evaluate biometric systems.

TEXT BOOKS:
1. James Wayman& Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation",Springerverlag London Ltd, 2005, USA.
2. Paul Reid," Biometrics for Network Security, Pearson Education, 2004

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"
3. S.Y. Kung, S.H. Lin, M.W., "Biometric Authentication: A Machine Learning Approach"
4. John Chirillo, Scott Blaul, "Implementing Biometric Security**",** John Wiley, 2003
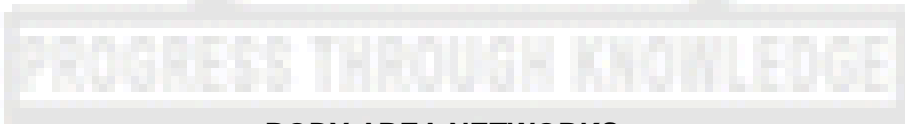
BM7006	BODY AREA NETWORKS	L T P C
		3 0 0 3

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 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

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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

OUTCOMES:
At the end of the course the student should be able to
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Design a BAN for appropriate application in medicine
- Assess the efficiency of communication and the security parameters

TEXT BOOKS:
1. Annalisa Bonfiglio, Danilo De Rossi ,"Wearable Monitoring Systems", Springer, 2011.(Unit I, II, III & V).
2. Sandeep K.S. Gupta,Tridib Mukherjee,Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013. (Unit IV).

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.

| BM7007 | BRAIN COMPUTER INTERFACE 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
- 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 controllers, Case study of Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Evaluate BCI
- Assign functions appropriately to the human and to the machine
- Develop high-fidelity BCI prototypes

TEXT BOOKS:

1. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "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.

BM7008	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, motherboards, PC based data acquisition and troubleshooting of PCs.

UNIT I INTEL ADVANCED PROCESSORS 9

8086, 80186, 80286, 80386, 80486 -Architecture, Memory management.

UNIT II PENTIUM PROCESSORS 9

Pentium Architecture- Memory Management- Pentium Pro microprocessors – Pentium II, Pentium III, Pentium 4 – Special features and software changes.

UNIT III   PC HARDWARE OVERVIEW   9

Functional units & Interconnection, New generation motherboards 286 to Pentium 4 Bus interface – ISA – EISA- VESA- PCI- PCIX, Memory and I/O port addresses, Peripheral interfaces and controller.

UNIT IV   PC BASED DATA ACQUISTION   9

Plug in data acquisition and control boards and programming- ADC, DAC, Digital I/O board and Timing Board, Serial port and parallel port programming. Data acquisition and programming using serial interfaces- PC and microcontroller serial ports, USB and IEEE 1394, Virtual lab tools.

UNIT V   TROUBLESHOOTING, MAINTAINING & REPAIRING   9

Memory troubleshooting, Monitor troubleshooting, Motherboard troubleshooting, Port troubleshooting, Sound Boards and Video adapters troubleshooting, USB troubleshooting.

OUTCOMES:
At the end of the course, the student should be able to:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Explain 8086 family of processors, motherboards, PC based data acquisition and troubleshooting of PCs

TOTAL : 45 PERIODS

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", II Edition, Tata Mc Graw Hill 2006.
3. Stephen J. Bigelow, "Troubleshooting, Maintaining &Repairing", Tata Mc Graw Hill Edition, 5th Edition.

BM7009	MEDICAL OPTICS	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 study about the optical properties of the tissues and the applications of laser in diagnosis and therapy.

UNIT I   OPTICAL PROPERTIES OF THE TISSUES   9

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal-Electromechanical – Photoabalative processes.

UNIT II   INSTRUMENTATION IN PHOTONICS   9

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.

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

OUTCOMES:
At the end of the course, the student should be able to:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Demonstrate knowledge of the fundamentals of optical properties of tissues
- Describe surgical applications of laser.
- Describe photonics and its therapeutic applications.

TEXT BOOKS:
1. Markolf H.Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. Paras N. Prasad, "Introduction to Biophotonics", 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.

BM7010	MEDICAL PHYSICS	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 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 (Technetium generator)

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.

OUTCOMES:

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

* To comprehend and appreciate the significance and role of this course in the present contemporary world
* Discuss the effect of light and sound in human body.
* Discuss the effects and measurement of ionizing radiation.

TEXT BOOKS:

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

REFERENCES:

1. P. Uma Devi, A. Nagarathnam , B S SatishRao , "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

BM7011	MEMS AND ITS BIOMEDICAL 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
* 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 AND 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.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Ability to comprehend and appreciate the significance and role of this course in the present
- contemporary world
- Discuss various MEMS fabrication techniques.
- Explain different types of sensors and actuators and their principles of operation at the micro scale level.
- Design MEMS device 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 Microelectromechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
4. Nitaigour Premchand Mahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007

BM7012	**NEURAL ENGINEERING**	**L T P C**

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; Blood Brain barrier.

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.

UNIT III   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.

UNIT IV   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 V   NERVE RECONSTRUCTION AND REPAIRING   9
Regeneration of the peripheral nervous system. Nerve graft; Neural tissue engineering; Drug delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Explain the structure of human nervous system
- Apply neural tissue engineering for rehabilitation
- Discuss about Regeneration of nervous system

TEXT BOOKS:
1. Mathews G.G. "Neurobiology", 2nd edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter, "Textbook 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.

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BM7013   **PHYSIOLOGICAL MODELING**   **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, 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   TRANSIENT AND FEEDBACK   9
Review of transient and stability analysis. Homeostasis, representation, finger tracking. Characterization of Physiological Feedback systems- Hypophysis adrenal systems. Non linear 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 CARDIO PULMONARY 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
OUTCOMES:
At the end of the course, the student should be able to:
- Explain application of Physiological models.
- Model dynamically varying physiological system
- Analyze and synthesize dynamic models of physiological system
- Develop differential equations to describe the dynamic models, simulate and visualize
- 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.

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REFERENCES:
1. ManfreoClynes and John H.Milsum, Biomedical Engineering System , McGraw Hill and Co.,New York , 1970.
2. Richard Skalak and ShuChien , Hand Book of Biomedical Engineering , McGraw Hill and Co.New York, 1987.
3. Douglas S.Rigg. Control Theory and Physiological Feedback Mechanism, TheWilkliam and Wilkins Co. Baltimore, 1970.
4. Joseph D, Bronzino, "The Biomedical Engineering Handbook", CRC Press, 3rdedition, 2006.
5. Christof Koch, "Biophysics of Computation", Oxford University Press, 28-Oct-2004.
6. F.C. Hoppensteadt and C.S.Peskin, "Modeling and Simulation in Medicine and the Life Sciences" (2nd Edition), by Springer (2002) ISBN: 0-387-95072-9.

BM7014	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 biomaterials in tissue replacements

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

UNIT II   STEM CELLS   9
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 III   COMPONENTS OF TISSUE ENGINEERING   9
Cell and Drug delivery systems - Transplantation – Implantation - Synthetic components– nanotechnology in tissue engineering – Imaging methods: SEM, TEM, Fluorescent and Confocal microscopy.

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.

UNIT V   APPLICATION OF TISSUE ENGINEERING   9
Replacement Engineering: Artificial organs – cartilage, skin blood, pancreas, kidney and liver. Regenerative engineering: peripheral Nerve regeneration – cardiac tissue regeneration – muscle regeneration.

TOTAL : 45 PERIODS

OUTCOMES:
After the completion of these course students able to:
- Acquire ability to function on multi-disciplinary teams
- Apply the knowledge of professional and ethical responsibility in use of stem cells and gene   therapy in creating tissue engineered therapies.
- Gain knowledge in research or clinical application on tissue repair/ engineering.

Attested

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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, 2013, Academic Press, USA.
3. R. Lanza, Anthony Atala, Handbook of Stem Cells, Academic Press, USA 2012.

BM7015	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, rehabilitation engineering. Measurement and assessment.   Rehabilitation Engineering - Fundamental principles, structure, function, performance and behavior. Subjective and objective measurement methods.

**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

OUTCOMES:

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

- Devise new concepts for future development and applications.
- Design and develop different sensory assist devices, orthotics and prosthetics for rehabilitation applications.

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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,1 edition,CRC Press,2007
2. Sunder 'Textbook 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. LoPresti; Handbook of Neuroprosthetic Methods CRC; edition 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.

BM7016	VIRTUAL REALITY	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.

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

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the student should be able to
- Comprehend and appreciate the significance and role of this course in the present contemporary world
- understand the basic concepts of Virtual reality
- expose the concept of Virtual Reality Programming with toolkits.
- Design of various modeling concepts.
- 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.

BM7017	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, Data mining

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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OUTCOMES:

At the end of the course the student should be able to

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Choose appropriate sensors and signal processing techniques for wearable systems
- Assess the energy requirement for a wearable system
- Evaluate the security issues related to wearable systems

TEXT BOOKS:

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

REFERENCES:

1. Hang,Yuan-Ting,"Wearable medical sensors and systems",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 Personalised Health Management - State of the art and future challenges ' IOS press, The Netherlands, 2004

EC7022   **INTERNET AND JAVA**   **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 various concepts of internetworking with TCP/IP
- To introduce the principles of world wide web
- To introduce Java programming and Java script programming
- To teach students to develop simple web pages with data bases

UNIT I   INTERNET WORKING WITH TCP/IP   9
Review of network technologies, Internet addressing, Address resolution protocols (ARP/ RARP), Routing IP data grams Reliable stream transport service (TCP) TCP/IP over ATM networks, Internet applications-E-mail, Telnet, FTP, NFS, Internet traffic management.

UNIT II   WORLD WIDE WEB   9
HTTP protocol, Web browsers Netscape, Internet explorer, Web site and web page design, HTML,XHTML, XML, CSS, Dynamic HTML, CGI.

UNIT III   JAVASCRIPT PROGRAMMING   9

Introduction, Control statements, Functions, Arrays and Objects – Programming

UNIT IV   JAVA PROGRAMMING   9
Language features, Classes, Object and methods. Sub-classing and dynamic binding, Multithreading, Overview of class library, Object method serialization, Remote method invocation, Java Servelets and Javaserver pages.

UNIT V   WEB DESIGN AND DATABASES   9
Macromedia Dream Weaver, Web Servers, Databases – SQL, MYSQL, DBI and ADO.NET, Web design

TOTAL : 45 PERIODS

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

At the end of the course, the student should be able to:
- Implement Java programs.
- Create a basic website using HTML and Cascading Style Sheets.
- Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
- Design rich client presentation using AJAX.
- Design and implement simple web page in PHP, and to present data in XML format.
- Design and implement server side programs using Servlets and JSP.

TEXT BOOKS:
1. Deitel, Internet and World Wide Web, Pearson Education / PHI, 2007
2. Deitel, "Java How to Program", Pearson Education / PHI, 2006.

REFERENCES:
1. Herbert Schildt, The complete Reference JAVA 2, Fifth Edition, Tata McGRaw Hill Publishing Com.Ltd, New Delhi.
2. A S Godbole A Kahate, "Web Technoligies, TCP/IP to Internet Application Archtiectures", TMH 2007
3. Margaret Levine Young, "Internet The Complete Reference", Tata McGraw Hill, 1999
4. Balagurusamy.E.`Programming with Java, A premier` Second Edition, Tata McGraw Hill,2006
5. Douglas E.Comer,"Internetworking with TCP/IP", Vol 1: 3rd edition, Prentice Hall of India, 1999.
6. Cay S. Horstmann & Gary Cornell, Core Java^{tm} Volume – I & II, Pearson Education, 2006

EC7071   **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

OUTCOMES:

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
  The students will be able to
- Define, formulate and analyze microcontroller based system.
- Ability to work with PIC, R8C and MSP 430 microcontroller for a specific real world application.
- Ability to describe the architecture and programming of PIC, R8C and MSP 430 microcontroller
- Manage a project from start to finish

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 ISBN No.978-1-935772-98-9. © 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.

EC7072   **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 authentication– 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

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- The student have gained the knowledge about the importance of security for networks, use of number theory and Galois field concepts.
- The student would have ability to design new symmetric and Asymmetric key crypto system
- The student would have ability to develop new authentication and key management techniques.

TEXT BOOKS:
1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill, 2007.
2. W.Stallings, "Cryptography & Network Security: Principles and Practice", Prentice Hall, Third 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, Second Edition, 2003.

EC7073	ELECTRO MAGNETIC INTERFERENCE AND	L T P C
	COMPATIBILITY	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.

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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

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
- To design a EMI free system
- To reduce system level crosstalk
- To design high speed Printed Circuit board with minimum interference
- To make our world free from unwanted electromagnetic environment

TEXT BOOKS:
1. V.P. Kodali, ―Engineering EMC Principles, Measurements and Technologies‖, IEEE Press, Newyork, 2010 (2nd Edition)
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 Ed, Artech house, Norwood, 1987
2. C.R. Paul, ―Introduction to Electromagnetic Compatibility‖, John wiley & sons Inc. 2006

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EC7074   **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

UNITI   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

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to apply the knowledge on quantum mechanics concepts, approximations and statistical mechanics related to nano systems

TEXT BOOKS:
1. Hagelstein, Peter L., Stephen D. Senturia, and Terry P. Orlando, "Introduction toApplied Quantum and Statistical Physics.", New York, NY: Wiley, 2004.
2. Rainer Waser, "Nanoelectronics and Information Technology", Wiley 2005
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 Nanoelectronics: Life with and after CMOS" , Vol I, II, and III, Kluwer Academic, 2005.

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EC 7075   **MULTIMEDIA COMPRESSION AND NETWORKS**   **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 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
OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Various components of multimedia have been studied
- Compressions and decompressions of multimedia components are explored
- The adaptation of compression techniques in various state-of-the-art technologies were observed

TEXT BOOKS:
1. Fred Halshall, "Multimedia communication- Applications, Networks, Protocols and Standards", Pearson education, 2007.
2. Tay Vaughan, "Multideai: Making It Work", 7/e, TMH, 2007.

REFERENCES:
1. Kurose and W.Ross, "Computer Networking "A Top Down Approach, Pearson education, 3rd edition, 2005.
2. K. R. Rao, Z. S. Bojkovic, D. A. Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007
3. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, First edition, 1995.
4. Ranjan Parekh, "Principles of Multimedia", TMH, 2006

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EC7076   **REAL TIME AND 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.
- To study about the basics of the buses used for embedded system networking.

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

OUTCOMES:
At the end of the course, the student should be able to:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to design and develop ARM processor based systems.
- Ability to develop embedded system for entertainment, communication and medical applications.
- Ability to implement distributed embedded computing platform and proper scheduling of the process.

TEXT BOOKS:
1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Morgan Kaufmann Publisher (An imprint of Elsevier), Second 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.

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REFERENCES:
1. David E-Simon, "An Embedded Software Primer", 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.

EC7077 **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

UNIT I   SCOPE OF ROBOTS   4
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
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

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Ability to design and develop robotic based systems.
- Ability to develop system for industrial automation and medical applications.
- 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", Second Edition, McGraw-Hill, 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.

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REFERENCES:
1. Mikell P.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.

EC7078	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 Mutilayer Perceptrons – 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

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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:
- Apply various soft computing frame works.
- Design of various neural networks.
- Use fuzzy logic.
- 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.
6. Amit Konar, "Artificial Intelligence and Soft Computing Behaviour and Cognitive model of the human brain", CRC Press, 2008.

EC7079

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SPEECH PROCESSING

</div>

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 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.

<div align="center">98</div>

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 sub-word 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

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- To design fundamental algorithms for speech synthesis, coding and recognition
- To design systems for realizing multimedia applications with basic speech signal processing techniques

TEXT BOOKS:
1. Lawrence RabinerandBiing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2002.

REFERENCES:
1. Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997.
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 Lucio PrinaRicotti, "Speech Recognition", John Wiley and Sons, 1999.
5. Ben Gold and Nelson Morgan, "Speech and audio signal processing, Processing and Perception of Speech and Music", Wiley- India Edition, 2006 Edition.

EC7551	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, 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.

UNIT I   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

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Describe data representation, instruction formats and the operation of a digital computer. (Level – II (Comprehension))
- Illustrate the data path unit and control unit for ALU operation. (Level – II (Comprehension))
- Discuss about implementation schemes of control unit and pipeline performance. (Level – II (Comprehension))
- Explain the concept of various memories, interfacing and organization of multiple processors. (Level – II (Comprehension))
- 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, Third edition, 1998.
2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, " Computer Organisation", V edition, McGraw-Hill Inc, 1996.

REFERENCES:
1. Morris Mano, "Computer System Architecture", Prentice-Hall of India, 2000.
2. Behrooz Paraami, "Computer Architecture, From Microprocessor to Supercomputers", , Oxford University Press, Sixth impression 2010.
3. P.Pal Chaudhuri, "Computer organization and design", 2nd Ed., Prentice Hall of India, 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, Eighth Edition 2010.

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EC7651   **VLSI DESIGN**   **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 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
MOS Technology and VLSI, Pass transistors, NMOS, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modeling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore's constant, Logical Effort. Case study: Study of technology development in MOS.

UNIT II   COMBINATIONAL LOGIC CIRCUITS   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, Dual Rail logic, NP CMOS logic and NOR array logic.

UNIT III   SEQUENTIAL LOGIC CIRCUITS   9
Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

UNIT IV   DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING   9
Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing- Manufacturing test principles- Design for testability. 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)

                                                            TOTAL:45 PERIODS

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

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REFERENCES:
1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI DESIGN", A system Perspective, second edition, Addision Wesley 2004.
2. A.Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Third edition, Prentice Hall of India, 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", 2005 Prentice Hall of India

GE7071	DISASTER MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:
- To provide students an exposure to disasters, their significance and type To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I   INTRODUCTION TO DISASTERS   9
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II   APPROACHES TO DISASTER RISK REDUCTION (DRR)   9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders-institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III   INTER-RELATIONSHIP BETWEEN DISASTERS AND
                  DEVELOPMENT   9**
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV   DISASTER RISK MANAGEMENT IN INDIA   9
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

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UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management

TEXT BOOKS:
1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN- 13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India EducationPvt.Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:
1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

GE7072	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.

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

OUTCOMES:
Upon completion of the course, the students will be able to:
- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- 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.

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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.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

GE7074	HUMAN RIGHTS	L T P C
		3 0 0 3

OBJECTIVES :
- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I   **9**
Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II   **9**
Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III   **9**
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV   **9**
Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V   **9**
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOMES:
- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:
1. Kapoor S.K., —Human Rights under International law and Indian Laws‖, Central Law Agency, Allahabad, 2014.
2. Chandra U., —Human Rights‖, Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

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GE7351   **ENGINEERING ETHICS AND HUMAN VALUES**   **L T P C**
                    (Common to all branches)   **3 0 0 3**

OBJECTIVES
- To emphasis into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

UNIT I   HUMAN VALUES   3
Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

UNIT II   ENGINEERING ETHICS   9
Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

UNIT III   ENGINEERING AS SOCIAL EXPERIMENTATION   9
Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.

UNIT IV   ENGINEER'S RIGHTS AND RESPONSIBILITIESON   SAFETY   12

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and Chernobyl as case studies.

UNIT V   GLOBAL ISSUES   12
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-Sample code of conduct.

                                                            TOTAL : 45 PERIODS
OUTCOMES:
- Students will have the ability to perform with professionalism , understand their rights, legal, ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

TEXT BOOKS:
1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:
1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

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GE7652	**TOTAL QUALITY MANAGEMENT**	**L T P C**
		3 0 0 3

AIM:
To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES:
- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9
Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning--Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9
The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA Documentation, Stages, Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9
Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures-- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9
Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise.
- Ability to apply the various tools and techniques of TQM.
- Ability to apply QMS and EMS in any organization.

TEXT BOOK:
1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:
1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

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