VELALAR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Thindal, Erode - 638 012

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai) (Accredited by NAAC with 'A' grade)



REGULATIONS 2018 Ver-4

CURRICULUM AND SYLLABUS (For the Students Admitted in AY 2021-22)

BE - BIOMEDICAL ENGINEERING

Choice Based Credit System (CBCS)

SUMMARY OF CREDITS

AUTONOMOUS REGULATION R-2018

S.	Subject			Cro	edits po	er seme	ster			C	redits	AI Cr	CTE edits
No	area	Ι	II	Ш	IV	V	VI	VII	VIII	Tot	Percen tage	Tot.	Perce ntage
1	HS	3	3					06		12	7.1%	12	7.5%
2	BS	11	5	4	4					24	14.3%	25	15.6%
3	ES	7	8	4	4					23	13.7%	24	15%
4	РС		7	11	16	15	12	4		65	38.6%	48	30%
5	PE					6	6	6		18	10.7%	21	11.2%
6	OE					3	3	3		09	5.3%	21	11.2%
7	EEC/ PSI			0	0	0	3	2	12	17	10.1%	15	9.3%
8	МС	~		✓	✓	√	~	✓					
Cre	Total edits/Sem	21	23	19	24	24	24	21	12		168	1	160

- 1. Humanities and Social Science(HS)
- 2. Basic Science(BS)
- 3. Engineering Science(ES)
- 4. Professional Core(PC)
- 5. Professional Elective(PE)
- 6. Open Elective(OE)
- 7. Employability Enhancement Course(EEC)/Project Seminar Internship(PSI)
- 8. Mandatory Course(MC)

		25	and the second				VELALAR COLLEGE OF ENGINEERING AND TECHNO	JUG	v	(CURR	ICULU	JM	
			Y		VELALAR COLLEGE OF ENGINEERING AND (Autonomous) Biomedical Engineering (BM) B.E- BM I Code Course Title THEORY T 1 Code Communicative English – I T 1 Engineering Mathematics – I T 1 Engineering Chemistry T 1 Engineering Chemistry T 1 Basic Electrical Engineering PRACTICALS PRACTICALS L 1 Physics and Chemistry Laboratory – I L 1 Physics and Chemistry Laboratory – I L 1 Inviversal Human Values-1 Total credits 1 Q 2 1 ode Course Title T 2 1 Engineering Mathematics-II T 2 1 Engineering Mathematics-II T 2 1 Engineering Mathematics-II Course Title Course Title I Engineering Mathematics-II I T 2 I Engineering Mathematics-II				1	1	UG		-	
		VCI				_					R – 20	18 – Ve	er 3	
	I	Jepart	tment				Biomedical Engineering (BM)							
]	Progra	mme				B.E- BM							
	N	Seme	ster								s			
Sl. No	ategor		Course	e Co	de		Course Title	Hou	rs / W	/eek	redit	M	ax. Ma	rks
	U						THEORY	L	T	P	Ŭ	CA	SE	lot
1	цс	21	FN	Т	1	1	Communicative English I	2	0	0	2	40	60	100
1	пз	21			1	1		5	0	0	5	40	00	100
2	BS	21	MA	1	1	1	Engineering Mathematics – I	3	1	0	4	40	60	100
3	BS	21	PH	T	1	1	Engineering Physics	3	0	0	3	40	60	100
4	BS	21	CY	T	1	1	Engineering Chemistry	3	0	0	3	40	60	100
5	ES	21	CS	T	1	3	Python Programming	3	0	0	3	40	60	100
6	ES	21	EC	T	2	1	Basic Electrical Engineering	3	0	0	3	40	60	100
							PRACTICALS							
7	BS	21	PH	L	1	1	Physics and Chemistry Laboratory – I	0	0	2	1	60	40	100
8	ES	21	CS	L	1	3	Python Programming Laboratory	0	0	2	1	60	40	100
9	MC	21	MC	L	1	1	Universal Human Values-1	1	0	1	0	100	0	100
							Total credits for Sem	1			21			
		Seme	ster				2							
SI. No	BS21CYT11Engineering Chemistry3ES21CST13Python Programming3ES21ECT21Basic Electrical Engineering3PRACTICALSBS21PHL11Physics and Chemistry Laboratory – I0ES21CSL13Python Programming Laboratory – I0ES21MCL11Universal Human Values-11Total credits for Sem1Semester2Course CodeCourse Title											М	ax. Ma	rks
							•	L	T	P		CA	SE	Tot.
						1.	THEORY							1
1	HS	21	EN	T	2	1	Communicative English – II	3	0	0	3	40	60	100
2	BS	21	MA	T	2	1	Engineering Mathematics-II	3	1	0	4	40	60	100
3	ES	21	BM	T	2	1	Biochemistry	3	0	0	3	40	60	100
4	PC	21	BM	T	2	2	Human Anatomy and Physiology	3	0	0	3	40	60	100
5	PC	21	BM	T	2	3	Medical Physics	3	0	0	3	40	60	100
6	ES	21	ME	C	1	1	Engineering Graphics	2	0	4	4	40	60	100
			1				PRACTICALS			1			1	1
7	BS	21	PH	L	2	1	Physics and Chemistry Laboratory – II	0	0	2	1	60	40	100
8	ES	21	ME	L	2	1	Workshop Practices Laboratory	0	0	2	1	100	0	100
9	PC	21	BM	L	2	1	Biochemistry and Human Physiology Laboratory	0	0	2	1	60	40	100
							Total credits for Sem	2			23			

	S	Semes	ter			3								
SI N o	Category	С	ourse	Cod	le		Course Title	Но	ırs / We	ek	Credit	M	lax. Ma	rks
								L	Т	Р	•	CA	SE	Tot.
							THEORY		ľ	'				
1	BS	21	MA	Т	3	1	Transforms and Partial Differential Equations	3	1	0	4	40	60	100
2	PC	21	EC	Т	3	1	Signals and Systems	3	1	0	4	40	60	100
3	PC	21	BM	Т	3	1	Pathology and Microbiology	3	0	0	3	40	60	100
4	PC	21	BM	Т	3	2	Sensors and Measurements	3	0	0	3	40	60	100
5	ES	21	BM	Т	3	3	Semiconductor Devices	3	0	0	3	40	60	100
6	MC	21	MC	Т	0	2	Environmental Science and Engineering	2	0	0	0	100	0	100
							PRACTICALS							
7	ES	21	EC	L	2	1	Circuits and Devices Laboratory	0	0	2	1	60	40	100
8	PC	21	BM	L	3	1	Pathology and Microbiology Laboratory	0	0	2	1	60	40	100
9	MC 21 MC				0	3	Essential English For Professionals	0	0	2	0	100	0	100
							Total credits for Sem	3			19			
GL	<u>></u>	Semest	ter			4								
SI N O	Categor		Cours	e Co	ode		Course Title	Нот	ırs / We	ek	Credit	N	/lax. Ma	arks
								L	Т	Р	-	CA	SE	Tot.
						1	THEORY							1
1	BS	21	MA	T	4	1	Probability and Random Processes	3	1	0	4	40	60	100
2	ES	21	IT	C	4	1	Data Structures using Object Oriented Programming concepts	3	0	2	4	50	50	100
3	PC	21	BM	T	4	1	Electronic Circuits	3	1	0	4	40	60	100
4	PC	21	BM	T	4	2	Analog and Digital Integrated Circuits	3	1	0	4	40	60	100
5	PC	21	BM	T	4	3	Biomaterials and Artificial Organs	3	0	0	3	40	60	100
6	PC	21	BM	T	4	4	Hospital Management	3	0	0	3	40	60	100
	1						PRACTICALS				1		1	1
7	PC	21	BM	L	4	1	Electronic Circuits Laboratory	0	0	2	1	60	40	100
8	PC	21	BM	L	4	2	Analog and Digital Integrated Circuits Laboratory	0	0	2	1	60	40	100
9	MC	21	MC	L	0	4	Professional Communication	0	0	2	0	100	0	100
							Total credits for Sem	4			24			

	;	Semes	ster			5								
SI No	Category		Cours	e C	ode		Course Title	Hou	irs / We	ek	Credit	Ma	x. Marl	ks
	•							L	Т	Р		CA	SE	Tot.
			1	1	-	1	THEORY		1	1	<u> </u>			
1	PC	21	BM	Т	5	1	Microprocessor and Microcontroller	3	0	0	3	40	60	100
2	PC	21	BM	Т	5	2	Medical Instrumentation – I	3	0	0	3	40	60	100
3	PC	21	BM	T	5	3	Bio Control Systems	3	1	0	4	40	60	100
4	PE						Professional Elective – I	3	0	0	3	40	60	100
5	PE						Professional Elective – II	3	0	0	3	40	60	100
6	OE						Open elective-I	3	0	0	3	40	60	100
7	MC	21	MC	Т	0	5	Aptitude and Logical Reasoning	2	0	0	0	100	0	100
	-	1	1	1		1	PRACTICALS	I	1	1	1	1	1	1
8	PC	21	BM	L	5	1	Microprocessor and Microcontroller Laboratory	0	0	2	1	60	40	100
9	PC	21	BM	L	5	2	Medical Instrumentation Laboratory - I	0	0	2	1	60	40	100
10	MC	21	MC	L	0	9	Communication Skills Laboratory	0	0	2	0	100	0	100
							Total credits for Sem	5			24		·	
	;	Semes	ster			6		-						
SI No	Category		Cours	e Co	de		Course Title	Ηοι	ırs / We	ek	Credit	Ma	ax. Mar	ks
								L	Т	Р		CA	SE	Tot.
			1	1		1	THEORY	I	1	1	1	1	T	1
1	PC	21	BM	Т	6	1	Biosignal Processing	3	1	0	4	40	60	100
2	PC	21	BM	Т	6	2	Medical Instrumentation - II	3	0	0	3	40	60	100
3	PC	21	BM	Т	6	3	Radiological Equipment	3	0	0	3	40	60	100
4	PE						Professional Elective – III	3	0	0	3	40	60	100
5	PE						Professional Elective – IV	3	0	0	3	40	60	100
6	OE						Open Elective – II	3	0	0	3	40	60	100
7	MC	21	MC	Т	0	7	Arithmetic and Analytical ability	2	0	0	0	100	0	100
			1	1		1	PRACTICALS	I	1	1	1	1		
8	PC	21	BM	L	6	1	Biosignal Processing Laboratory	0	0	2	1	60	40	100
9	PC	21	BM	L	6	2	Medical Instrumentation Laboratory – II	0	0	2	1	60	40	100
10	PSI	21	BM	L	6	3	Mini Project	0	0	6	3	40	60	100
							Total credits for Sem	6			24			_

	Semes	ster		7										
SI	ory							Ho	ours / V	Veek	lit	Ma	x. Ma	rks
No	Categ		Co	ourse	Cod	e	Course Title	L	Т	Р	Cred	CA	SE	Tot.
							THEORY							
1	HS	21	IT	Т	, ,	7 1	Economics and Management for Engineers	3	0	0	3	40	60	100
2	HS	21	HS	Т		7 1	Human Values and Professional Ethics	3	0	0	3	40	60	100
3	PC	21	BM	1 T		7 2	Digital Image Processing	3	0	0	3	40	60	100
4	PE						Professional Elective - V	3	0	0	3	40	60	100
5	PE						Professional Elective - VI	3	0	0	3	40	60	100
6	OE						Open Elective – III	3	0	0	3	40	60	100
7	MC	21	MC	СТ		0 8	Indian Constitution and Traditional knowledge	2	0	0	0	100	0	100
							PRACTICALS							
8	PC	21	BM	1 L		7 1	Digital Image Processing Laboratory	0	0	2	1	60	40	100
9	PSI	21	BM	1 L		7 2	Hospital Training	0	0	4	2	60	40	100
	•						Total credits for Sem	7		1	21			
	Semes	ster		8										
SI.	gory		~					Ho	urs / V	Veek	dit	Ma	x. Ma	rks
No	Categ		Cou	irse C	Code		Course Title	L	Т	Р	Cre	CA	SE	Tot.
							PRACTICALS							
10	PSI	21	BM	L	8	1	Internship	-	-	-	2	100	0	100
11	PSI	21	BM	L	8	2	Project Work	-	-	20	10	40	60	100
			1			1	Total credits for Sem	8		1	12			
							Total Programme Credit	168	; ;			·		

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
Healthcare Devices	Signal & Image	Communication &	Mechanics & Systems	Bio Engineering	Healthcare
	Processing	Networks			Management
Biosensors and Transducers	Speech Processing	Analog and Digital Communication	Biomechanics	BioMEMS & NEMS	Modern Trends in Planning and Design of Hospitals
Wearable Systems	Biometric Systems	Computer Networks	Biofluids & Dynamics	Principles of Tissue Engineering	Electrical Safety & Quality Assurance
Human Assist Devices	Computer Vision	Embedded Systems and IoT	Rehabilitation Engineering	Principles of Genetic Engineering	Medical Ethics & Standards
Virtual Reality in Medicine	Virtual Instrumentation	Wireless Sensor Networks	Physiological Modeling	Pharmaceutical Engineering	Foundation Skills in Integrated Product Development
Ophthalmology and Dentistry Equipment	Healthcare Analytics	Body Area Networks	Robotics in Medicine	Biophotonics	Biomedical Waste Management
Surgical Assist Devices	Pattern Recognition & Neural Network	Medical Informatics	Biomimetics	Analytical Instrumentation	Troubleshooting of Medical Equipment
Medical Device Design	Brain Computer Interface & Applications	Telehealth Technology	Forensic Science in Healthcare	Biostatistics	Medical Device Regulation & Safety

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honors) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honors) or Minor degree also. For more details on B.E./B.Tech (Honors) or Minor degree refer to the Regulations 2021.

							VERTICAL I: Healthcare Device	es						
SI.No	Category		Со	ourse C	Code		Course Title	Hou	rs / V	Veek	Credit	Ma	ax. Ma	rks
								L	Т	Р		СА	SE	Tot.
1	PE	21	BM	Е	1	1	Biosensors and Transducers	3	0	0	3	40	60	100
2	PE	21	BM	Е	1	2	Wearable Systems	3	0	0	3	40	60	100
3	PE	21	BM	E	1	3	Human Assist Devices	3	0	0	3	40	60	100
4	PE	21	BM	Е	1	4	Virtual Reality in Medicine	3	0	0	3	40	60	100
5	PE	21	BM	Е	1	5	Ophthalmology and Dentistry Equipment	3	0	0	3	40	60	100
6	PE	21	1 BM E 1 1 BM E 1				Surgical Assist Devices	3	0	0	3	40	60	100
7	PE	21	BM	Е	1	7	Medical Device Design	3	0	0	3	40	60	100

PROFESSIONAL ELECTIVE COURSES: VERTICALS

							VERTICAL II: Signal & Image Proce	essing						
SI.No	Category		Co	ourse	Code		Course Title	Hou	irs / V	Veek	Credit	Ma	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	PE	21	BM	Е	2	1	Speech Processing	3	0	0	3	40	60	100
2	PE	21	BM	Е	2	2	Biometric Systems	3	0	0	3	40	60	100
3	PE	21	BM	Е	2	3	Computer Vision	3	0	0	3	40	60	100
4	PE	21	BM	E	2	4	Virtual Instrumentation	3	0	0	3	40	60	100
5	PE	21	BM	Е	2	5	Healthcare Analytics	3	0	0	3	40	60	100
6	PE	21	BM	E	2	6	Pattern Recognition & Neural Network	3	0	0	3	40	60	100
7	PE	21	BM	Е	2	7	Brain Computer Interface & Applications	3	0	0	3	40	60	100

							VERTICAL III: Communication & Net	tworks	5					
SI.No	Category		Co	ourse C	ode		Course Title	Hou	rs / V	Veek	Credit	Ma	ix. Mai	·ks
								L	Т	Р		CA	SE	Tot.
1	PE	21	BM	Е	3	1	Analog and Digital Communication	3	0	0	3	40	60	100
2	PE	21	BM	Е	3	2	Computer Networks	3	0	0	3	40	60	100
3	PE	21	BM	Е	3	3	Embedded Systems and IoT	3	0	0	3	40	60	100
4	PE	21	BM	Е	3	4	Wireless Sensor Networks	3	0	0	3	40	60	100
5	PE	21	BM	Е	3	5	Body Area Networks	3	0	0	3	40	60	100
6	PE	21	BM	E	3	6	Medical Informatics	3	0	0	3	40	60	100
7	PE	21	BM	Е	3	7	Telehealth Technology	3	0	0	3	40	60	100

							VERTICAL IV: Mechanics & Syste	ms						
SLNo	Category		Co	urse C	Code		Course Title	Hou	rs / V	Veek	Credit	Ma	x. Mar	ks
			21 BM E 4					L	Т	Р		СА	SE	Tot.
1	PE	21	21 BM E 4 21 BM E 4			1	Biomechanics	3	0	0	3	40	60	100
2	PE	21	BM	Е	4	2	Biofluids & Dynamics	3	0	0	3	40	60	100
3	PE	21	BM	Е	4	3	Rehabilitation Engineering	3	0	0	3	40	60	100
4	PE	21	BM	Е	4	4	Physiological Modeling	3	0	0	3	40	60	100
5	PE	21	BM	Е	4	5	Robotics in Medicine	3	0	0	3	40	60	100
6	PE	21	BM	Е	4	6	Biomimetics	3	0	0	3	40	60	100
7	PE	21	BM	Е	4	7	Forensic Science in Healthcare	3	0	0	3	40	60	100

							VERTICAL V: Bio Engineering							
SI.No	Categor y		Co	urse Co	ode		Course Title	Hou	rs / V	Veek	Credit	Ma	x. Mai	·ks
								L	Т	Р		CA	SE	Tot.
1	PE	21	BM	Е	5	1	BioMEMS & NEMS	3	0	0	3	40	60	100
2	PE	21	BM	E	5	2	Principles of Tissue Engineering	3	0	0	3	40	60	100
3	PE	21	BM	E	5	3	Principles of Genetic Engineering	3	0	0	3	40	60	100
4	PE	21	BM	E	5	4	Pharmaceutical Engineering	3	0	0	3	40	60	100
5	PE	21	BM	E	5	5	Biophotonics	3	0	0	3	40	60	100
6	PE	21	BM	E	5	6	Analytical Instrumentation	3	0	0	3	40	60	100
7	PE	21	BM	Е	5	7	Biostatistics	3	0	0	3	40	60	100

							VERTICAL VI: Healthcare Management							
SLNo	Category		Co	urse Co	ode		Course Title	Hou	irs / V	Veek	Credit	Ma	x. Mar	'ks
								L	Т	Р		СА	SE	Tot.
1	PE	21	BM	Е	6	1	Modern Trends in Planning and Design of Hospitals	3	0	0	3	40	60	100
2	PE	21	BM	Е	6	2	Electrical Safety & Quality Assurance	3	0	0	3	40	60	100
3	PE	21	BM	Е	6	3	Medical Ethics & Standards	3	0	0	3	40	60	100
4	PE	21	BM	Е	6	4	Foundation Skills in Integrated Product Development	3	0	0	3	40	60	100
5	PE	21	BM	Е	6	5	Biomedical Waste Management	3	0	0	3	40	60	100
6	PE	21	BM	E	6	6	Troubleshooting of Medical Equipment	3	0	0	3	40	60	100
7	PE	21	BM	Е	6	7	Medical Device Regulation & Safety	3	0	0	3	40	60	100

							OPEN ELECTIVE – I (Offered to other De	epartm	ents)					
SI.No	Category		Co	urse Co	ode		Course Title	Hou	irs / V	Veek	Credit	Ma	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	OE	21	BM	0	0	1	Biotelemetry	3	0	0	3	40	60	100
2	OE	21	BM	0	0	2	Biometric systems and their applications	3	0	0	3	40	60	100

							OPEN ELECTIVE – II (Offered to other D	epartm	ents)					
SLNo	Categor y		Co	urse Co	ode		Course Title	Hou	irs / V	Veek	Credit	Max	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	OE	21	BM	0	0	3	Biology for Engineers	3	0	0	3	40	60	100
2	OE	21	BM	0	0	4	Healthcare Management Systems	3	0	0	3	40	60	100

							OPEN ELECTIVE – III (Offered to other D	epartn	ients)					
SI.No	Category		Co	urse Co	ode		Course Title	Hou	irs / V	Veek	Credit	Max	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	OE	21	BM	0	0	5	Medical Robotics	3	0	0	3	40	60	100
2	OE	21	BM	0	0	6	Rapid Prototyping	3	0	0	3	40	60	100

Open Electives (Offered by other Departments to B.E.Biomedical Engineering Programme)

						(Offer	OPEN ELECTIVES ed by the Department of Computer Science :	and Er	iginee	ering)				
SI.No	Category		Со	ourse C	ode		Course Title	Hou	rs / V	Veek	Credit	M	ax. Ma	rks
								L	Т	Р		CA	SE	Tot.
1	OE	21	CS	0	0	1	Cyber Security	3	0	0	3	40	60	100
2	OE	21	CS	0	0	2	Web Designing	3	0	0	3	40	60	100
3	OE	21	CS	0	0	3	Knowledge Management	3	0	0	3	40	60	100
4	OE	21	CS	0	0	4	Green Computing	3	0	0	3	40	60	100
5	OE	21	CS	0	0	5	Principles of Artificial Intelligence	3	0	0	3	40	60	100

							OPEN ELECTIVES (Offered by the Department of CIVIL Engi	neerin	g)					
Sl.No	Category		Cοι	irse Co	ode		Course Title	Hou	rs / V	Veek	Credit	Ma	ax. Ma	rks
								L	Т	Р		CA	SE	Tot.
1	OE	21	CE	0	0	1	Civil and Infrastructure Engineering	3	0	0	3	40	60	100
2	OE	21	CE	0	0	2	Environmental Pollution and Waste Management	3	0	0	3	40	60	100
3	OE	21	CE	0	0	3	Disaster Management and Mitigation	3	0	0	3	40	60	100
4	OE	21	CE	0	0	4	Building Services	3	0	0	3	40	60	100

				(Offe	red by t	OPEN ELECTIVES he Department of Electronics and Commu	nicatio	n Eng	gineerii	ng)			
SI.No	Category		Co	ourse C	Code		Course Title	Hou	rs / V	Veek	Credit	Ma	ax. Ma	rks
								L	Т	Р		CA	SE	Tot.
1	OE	21	EC	0	0	1	Automotive Electronics	3	0	0	3	40	60	100
2	OE	21	EC	0	0	2	SCILAB for Engineers	3	0	0	3	40	60	100
3	OE	21	EC	0	0	3	Satellite Applications	3	0	0	3	40	60	100
4	OE	21	EC	0	0	4	Consumer Electronics	3	0	0	3	40	60	100
5	OE	21	EC	0	0	5	Principles of communication Engineering	3	0	0	3	40	60	100
6	OE	21	EC	0	0	6	Microcontroller based system design	3	0	0	3	40	60	100

					(Of	fered b	OPEN ELECTIVES by the Department of Electrical and Electro	nics Er	nginee	ering)				
SI.No	Categor y		Co	urse C	ode		Course Title	Hou	irs / V	Veek	Credit	Ma	x. Mar	ks
								L	T	Р		CA	SE	Tot.
1	OE	21	EE	0	0	1	PLC and SCADA	3	0	0	3	40	60	100
2	OE	21	EE	0	0	2	Renewable Energy Sources	3	0	0	3	40	60	100
3	OE	21	EE	0	0	3	Embedded Real Time System	3	0	0	3	40	60	100
4	OE	21	EE	0	0	4	Energy Auditing and Conservation	3	0	0	3	40	60	100
5	OE	21	EE	0	0	5	Electric Vehicles	3	0	0	3	40	60	100

						(Offe	OPEN ELECTIVES red by the Department of Information and	l Techn	ology	r)				
SI.No	Category		Co	ourse C	ode		Course Title	Ηοι	ırs / V	Veek	Credit	Ma	ıx. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	OE	21	IT	0	0	1	Basics of Java Programming	3	0	0	3	40	60	100
2	OE	21	IT	0	0	2	Ethical Hacking	3	0	0	3	40	60	100
3	OE	21	IT	0	0	3	E-Commerce and Applications	3	0	0	3	40	60	100
4	OE	21	IT	0	0	4	Basics of Android Application Development	3	0	0	3	40	60	100
5	OE	21	IT	0	0	5	Principles of Data Science	3	0	0	3	40	60	100

						(O t	OPEN ELECTIVES fered by the Department of Mechanical En	gineer	ing)					
SI.No	Category		Co	ourse C	Code		Course Title	Hou	rs / V	Veek	Credit	Ma	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	OE	21	ME	0	0	1	Industrial Instrumentation	3	0	0	3	40	60	100
2	OE	21	ME	0	0	2	Product Design and Development	3	0	0	3	40	60	100
3	OE	21	ME	0	0	3	Sustainable Manufacturing	3	0	0	3	40	60	100
4	OE	21	ME	0	0	4	Entrepreneurship Development	3	0	0	3	40	60	100
5	OE	21	ME	0	0	5	Fundamentals of Ergonomics	3	0	0	3	40	60	100
6	OE	21	ME	0	0	6	Principles of Management and Industrial psychology	3	0	0	3	40	60	100
7	OE	21	ME	0	0	7	Safety Measures for Engineers	3	0	0	3	40	60	100

							OPEN ELECTIVES (Offered by Medical Electronics)							
Sl.No	Category		Coi	arse Co	ode		Course Title	Hou	irs / V	Veek	Credit	Ma	ıx. Mar	·ks
								L	Т	Р		СА	SE	Tot.
1	OE	21	MD	0	0	1	Introduction to Medical Electronics	3	0	0	3	40	60	100
2	OE	21	MD	0	0	2	Hospital waste Management	3	0	0	3	40	60	100
3	OE	21	MD	0	0	3	Hospital Information System	3	0	0	3	40	60	100
4	OE	21	MD	0	0	4	IOT Applications in Healthcare	3	0	0	3	40	60	100

							OPEN ELECTIVES (Offered by Science and Humanity))						
SI.No	Category		Co	urse Co	ode		Course Title	Hou	irs / V	Veek	Credit	Ma	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	OE	21	GE	0	0	1	National Cadet Corps Studies – I	3	0	0	3	40	60	100
2	OE	21	GE	0	0	2	National Cadet Corps Studies – II	3	0	0	3	40	60	100

							Value Added Courses							
SI.No	Category		Co	urse C	ode		Course Title	Hou	rs / V	Veek	Credit	Ma	x. Mar	ks
								L	Т	Р		CA	SE	Tot.
1	VC	21	BM	V	0	1	Industrial Internet of Things	0	0	2	1	100	0	100
2	VC	21	BM	V	0	2	Biomedical Signal and Image Processing using NI Vision and Biomedical Toolkit	0	0	2	1	100	0	100
3	VC	21	BM	V	0	3	Training on Machine Learning	0	0	2	1	100	0	100

<u>VERTICALS FOR MINOR DEGREE</u> (In addition to all the verticals of other programmes)

Vertical I Fintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration	Vertical IV Business Data Analytics	Vertical V Environmental and Sustainability	Vertical VI Artificial Intelligence
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development	Introduction to Data Science
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management	Principles of Artificial Intelligence
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials	Data Warehousing and Data Mining
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Digital Marketing and Social Network Analytics	Materials for Energy Sustainability	Machine Learning Techniques
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Supply Chain Analytics	Green Technology	Expert Systems
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis	Cognitive Science
-	-	-	-	Integrated Energy Planning for Sustainable Development	Gamification
-	-	-	-	Energy Efficiency for Sustainable Development	-

Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals										
S.	Course	Course Title		Periods / Week		edits	Max. Marks			
INO	No Code		Cat	L	Т	P	Cr	CA	SE	Tot.
	VERTICAL 1: FINTECH ANDBLOCK CHAIN									
1	21ITM11	Financial Management	MD	3	0	0	3	40	60	100
2	21ITM12	Fundamentals of Investment	MD	3	0	0	3	40	60	100
3	21ITM13	Banking, Financial Services and Insurance	MD	3	0	0	3	40	60	100
4	21ITM14	Introduction to Blockchain and its Applications	MD	3	0	0	3	40	60	100
5	21ITM15	Fintech Personal Finance and Payments	MD	3	0	0	3	40	60	100
6	21ITM16	Introduction to Fintech	MD	3	0	0	3	40	60	100
	VERTICAL 2: ENTREPRENEURSHIP									
1	21MEM21	Foundations of Entrepreneurship	MD	3	0	0	3	40	60	100
2	21MEM22	Team Building and Leadership Management for Business	MD	3	0	0	3	40	60	100
3	21MEM23	Creativity and Innovation in Entrepreneurship	MD	3	0	0	3	40	60	100
4	21MEM24	Principles of Marketing Management for Business	MD	3	0	0	3	40	60	100
5	21MEM25	Human Resource Management for Entrepreneurs	MD	3	0	0	3	40	60	100
6	21MEM26	Financing New Business Ventures	MD	3	0	0	3	40	60	100
	VERTICAL 3: PUBLIC ADMINISTRATION									1
1	21ECM31	Principles of Public Administration	MD	3	0	0	3	40	60	100
2	21ECM32	Constitution of India	MD	3	0	0	3	40	60	100
3	21ECM33	Public Personnel Administration	MD	3	0	0	3	40	60	100
4	21ECM34	Administrative Theories	MD	3	0	0	3	40	60	100
5	21ECM35	Indian Administrative System	MD	3	0	0	3	40	60	100
6	21ECM36	Public Policy Administration	MD	3	0	0	3	40	60	100
	VERTICAL 4: BUSINESS DATA ANALYTICS									
1	21CSM41	Statistics for Management	MD	3	0	0	3	40	60	100
2	21CSM42	Data mining for Business Intelligence	MD	3	0	0	3	40	60	100
3	21CSM43	Human Resource Analytics	MD	3	0	0	3	40	60	100
4	21CSM44	Digital Marketing and Social Network Analytics	MD	3	0	0	3	40	60	100
5	21CSM45	Supply Chain Analytics	MD	3	0	0	3	40	60	100
6	21CSM46	Financial Analytics	MD	3	0	0	3	40	60	100

	VERTICAL 5: ENVIRONMENTAL AND SUSTAINABILITY									
1	21CEM51	Sustainable infrastructure Development	MD	3	0	0	3	40	60	100
2	21CEM52	Sustainable Agriculture and Environmental Management		3	0	0	3	40	60	100
3	21CEM53	Sustainable Bio Materials	MD	3	0	0	3	40	60	100
4	21CEM54	Materials for Energy Sustainability	MD	3	0	0	3	40	60	100
5	21CEM55	Green Technology	MD	3	0	0	3	40	60	100
6	21CEM56	Environmental Quality Monitoring and Analysis	MD	3	0	0	3	40	60	100
7	21CEM57	Integrated Energy Planning for Sustainable Development	MD	3	0	0	3	40	60	100
8	21CEM58	Energy Efficiency for Sustainable Development	MD	3	0	0	3	40	60	100
VERTICAL 6: ARTIFICIAL INTELLIGENCE										
1	21CSM61	Introduction to Data Science	MD	3	0	0	3	40	60	100
2	21CSM62	Principles of Artificial Intelligence	MD	3	0	0	3	40	60	100
3	21CSM63	Data Warehousing and Data Mining	MD	3	0	0	3	40	60	100
4	21CSM64	Machine Learning Techniques	MD	3	0	0	3	40	60	100
5	21CSM65	Expert Systems	MD	3	0	0	3	40	60	100
6	21CSM66	Cognitive Science	MD	3	0	0	3	40	60	100
7	21CSM67	Gamification	MD	3	0	0	3	40	60	100

VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

21ENT11

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Communicative English-I aims at developing Communication Skills in English essential for the learner to handle English language for a variety of everyday purposes through acquisition of basic grammar and vocabulary along with necessary listening, speaking, reading and writing skills.

COMMUNICATIVE ENGLISH-I

(Common to all B.E/B.Tech Programmes)

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

- 1. Use a wide range of vocabulary in oral and written communication.
- 2. Use correct grammatical structures in speaking and writing.
- 3. Write clear and coherent informal Passages.
- 4. Follow different kinds of spoken excerpts and distinguish relevant from irrelevant information, grasp proper sentence pattern and vocabulary through reading
- 5. Give short informal presentations and participate in classroom discussions

UNIT 1 VOCABULARY

Synonyms and Antonyms- Single Word Substitutes - Use of Abbreviations and Acronyms-Homonyms and Homophones- Business Vocabulary - Commonly Confused Words- Collocation - British and American Vocabulary- Word formation.

UNIT 2 GRAMMAR

Comparative Adjectives - Modals -Phrasal Verbs -Tenses – Connectives-Impersonal Passive Voice -Types of Questions -Mechanics of Writing (Editing) -Direct and Indirect Speech- Numerical Adjectives - Gerunds and Infinitives- Expressions of Purpose- Conditional Sentences- Same Word Used as Different Parts of Speech – Subject Verb Agreement.

UNIT 3 INFORMAL WRITING

Letter Writing - Informal Letters - Dialogue Writing -Informal Dialogues – Essay Writing-Informal Essays Movie/Book Reviews.

UNIT 4 LANGUAGE ENHANCEMENT THROUGH LISTENING & READING

Listening Comprehension -Listening for General Ideas- Listening to You Tube Documentaries - Listening for Specific Information- Listening for Details-Listening for Vocabulary-BBC Learn English Videos -Reading Comprehension- Understanding General and Specific Information -Sign Post Words-Jumbled Sentences - Finding Topic Sentences and Supporting Arguments - Reading for Vocabulary-Reading News Papers.

UNIT 5 LANGUAGE ENHANCEMENT THROUGH SPEAKING

Introduction to IPA-Syllable, Stress, Intonation, etc., -Conversation Starters- Describing Places, People, Things and Pictures -Self Introduction - Narrating Personal Experiences and Incidents-Informal Group Discussions.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. Sanjay KumarandPushp Lata, "Communication Skills" 2nd Edition, Oxford University Press, New Delhi, 2017.
- 2. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.

REFERENCES:

- 1. Department of English, Anna University, "Mindscapes: English for Technologists and Engineers", 1st Edition, Orient Black Swan, Chennai. 2012.
- 2. Dhanavel, S.P, "English and Communication Skills for Students of Science and Engineering", 1st Edition, Orient Black Swan, Chennai. 2011.
- 3. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi, 2018.

e-RESOURCES:

- 1. <u>http://www.usingenglish.com</u>
- 2. https://www.khanacademy.org/humanities/grammar

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ENGINEERING MATHEMATICS I

(Common to all B.E/B.Tech Programmes)

21MAT11 Preamble:

The course aims at achieving conceptual understanding of topics such as Matrix Algebra and Calculus. The syllabus is designed to provide the skills for modeling engineering problems and understand the role of single variable and multivariables in the discipline of engineering and computer science.

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

- 1. Evaluate Eigen values, eigenvectors and diagonalization of symmetric matrices.
- 2. Use limit definition, understand differentiation and integration methods.
- 3. Compute curvature, centre of curvature, evolute and envelope of curves.
- 4. Express functions of two variables in Taylor's series and compute Jacobians, maximum and minimum values.
- 5. Apply multiple integrals to determine area in cartesian and polar coordinates and volume in Cartesian co ordinates.

UNIT 1 MATRICES

Characteristic equation - Eigen values and Eigenvectors of a real matrix - Properties of Eigenvalues and Eigenvectors - Statement and application of Cayley Hamilton Theorem - Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation. 9+3

UNIT 2 **CALCULUS**

Representation of functions – Mathematical Models – New Functions from Old Functions – Graphing Calculators and Computers - The Limit of a Function - Calculating Limits Using the Limit Laws - Continuity - Exponential Growth and Decay – Hyperbolic Functions – Areas and Distances – The Definite Integral – The Fundamental Theorem of Calculus – Improper Integrals.

GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS UNIT 3 9+3 Curvature - Radius, Centre and Circle of curvature in Cartesian and Parametric form - Evolute - Envelope of family of curves with one and two parameters - Evolute as the envelope of normals - Properties of Evolute and Envelope. 9+3

UNIT 4 **FUNCTIONS OF SEVERAL VARIABLES**

Partial derivatives - Total derivative - Differentiation of implicit functions - Jacobian- Properties - Taylor's series expansion for functions of two variables - constrained Maxima and Minima - Lagrange's multipliers with single constraint.

MULTIPLE INTEGRALS UNIT 5

Double integrals in Cartesian and Polar co ordinates- Change of order of Integration - Change of variables from Cartesian to Polar co ordinates - Area as a double integral in Cartesian and Polar form - Volume as a triple integral in Cartesian co ordinates.

Lecture : 60, Tutorial : 15, Total : 60

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TEXT BOOKS:

- Grewal B.S., "Higher Engineering Mathematics" 43rd Edition, Khanna Publishers, New Delhi, 2014. 1.
- 2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [Sections 1.1, 1.2, 1.3, 1.4, 2.2, 2.3, 2.5, 3.8, 3.11, 5.1, 5.2, 5.3 and 7.8].

REFERENCES:

- Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 26th Reprint, 1. New Delhi, 2016
- 2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
- 3. N.P.Bali, Manish Goyal, "Engineering Mathematics", Lakshmi Publications (PVT) Ltd, 4 th edition, 2014.

e-RESOURCES:

- http://nptel.ac.in/courses/111105035/"Advanced Engineering Mathematics", Prof. Pratima Panigrahi, 1. IndianInstitute of Technology, Kharagpur
- http://nptel.ac.in/courses/122104017/ " Mathematics-I", Prof. S.K. Ray, Indian Institute of Technology, 2. Kanpur

9+3

21PHT11

Preamble:

Ultrasonics forms the basis of Sonar and in the field of medicine for both diagnostics and therapeutic applications. Mechanical properties of Engineering materials are explored for industrial applications such as construction of bridges and railway wagons. Particle and wave nature of quantum particles form the basis of quantum computers .The virtues of lasers are explored in applications such as holography, computers ,space satellites and medicines.

ENGINEERING PHYSICS

(Common to all B.E/B.Tech Programmes)

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

- Demonstrate the knowledge of wave optics in propagation of light waves in optical fibers in 1. communications system.
- 2. Explain the production of Ultrasonics and its NDT techniques in scanning methods, medical applications.
- Describe the Elastic property of solid materials and thermal conductivity of solids in industrial applications. 3.
- 4. Explore the dual nature of light waves with quantum theory on Black body radiation and Schrodinger's wave equations.
- 5. Demonstrate the knowledge on Nd-YAG, CO₂, Semiconductor lasers in industrial applications of welding, heat treatment, cutting, medical treatment and holography.

WAVES AND OPTICS UNIT 1

Classification of waves-wave equation-(qualitative)-Typical and General wave equation-qualitative analysis of phase and group velocities of waves-Differential equation of simple harmonic motion-Forced oscillations -analysis and classification of damped oscillations through differential equations-coherent sources and incoherent sources. Superposition principle of Waves- Illustrations-Principle and propagation of light in optical fibers-numerical

aperture and acceptance angle-Types of optical fibers (material, refractive index, mode-Application of optical fibers.

UNIT 2 **ULTRASONICS**

Introduction - Production techniques- Magnetostriction effect- Piezoelectric effect - Piezoelectric generatordetection of ultrasonic waves - properties - cavitations - velocity measurement - acoustic grating - Industrial applications – drilling, welding, soldering and cleaning – SONAR - non destructive testing – pulse echo system, through transmission and reflection modes - A,B and C scan - medical applications - sonograms.

UNIT 3 **MECHANICAL AND THERMAL PROPERTIES**

Elasticity – Stress-strain diagram and its uses – factors affecting elastic modulus and tensile strength. Torsional stress and deformations - twisting couple - torsion pendulum: theory and experiment - bending of beams. Bending moment – cantilever, Young's Modulus by Uniform and non-uniform bending: theory and experiment – I-shaped girders.

Modes of heat transfer -thermal conductivity- Specific heat-Newton's law of cooling - Forbe's and Lee's disc method: theory and experiment- thermal insulation - applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT 4 **MODERN PHYSICS**

Wave- particle duality, de-Broglie matter waves, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Black body radiation - Planck's theory (derivation) - deduction of Wien's displacement law and Rayleigh - Jeans' law from Planck's theory - Matter waves - concept of operator-Eigen value and Eigen function- Physical significance of wave function -Schrodinger's time independent wave equation — Particle in a one dimensional box, qualitative explanation on wave equation and energy value in three dimensional box.

UNIT 5 LASER

Introduction - principle of spontaneous emission and stimulated emission, population inversion, pumping. Einstein's coefficients - derivation. Types of lasers- Nd-YAG-CO₂, Semiconductor lasers (homojunction & heterojunction) - Industrial applications - lasers in welding, heat treatment, cutting- medical applicationsholography-construction and reconstruction- Safety classes of laser.

TEXT BOOKS:

- Gaur R.K. and Gupta S.L., "Engineering Physics", 8th Edition, Dhanpat Rai publishers, 2009. 1.
- Mani Naidu S., "Engineering Physics", 2nd Edition, Pearson Publishing, 2011. 2.

Lecture : 45, Tutorial : 0, Total : 45

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REFERENCES:

- 1. Serway and Jewett, "Physics for Scientists and Engineers with Modern Physics", 9th Edition, Thomson Brooks Cole, 2013
- 2. Young H.D., Freedman R.A., Ford A.L., "Sears and Zemansky's University Physics with Modern Physics", 13th Ed, 2013.
- 3. Tipler P.A. and Mosca G.P., "Physics for Scientists and Engineers with Modern Physics", 6th Edition, W.H.Freeman, 2007.

- 1. <u>http://nptel.ac.in/courses/115101003</u>, "Atomic and Molecular Physics" Dr. T. Kundu, IIT Bombay.
- 2. <u>https://www.khanacademy.org/science/physics/quantum-physics</u>

21CYT11

Preamble:

The study of water technology enables engineers to acquire skills to make the simple design calculation of drinking water as well as industrial water treatment. Electrochemistry and corrosion explain the fundamentals. corrosion prevention, identification and implementation for solving electrochemical and corrosion problems. The study of energy storage devices exposes some of the most commonly used energy storage technologies. Instrumental methods and analysis describe basic concepts and promote to solve real analytical problems. Studies of Nano chemistry span many areas as assemblies significant new structures like nanowire, nanotube and lab-inchip devices

ENGINEERING CHEMISTRY

(Common to all B.E/B.Tech Programmes)

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

- 1. Evaluate the process to purify hard water using ion-exchange, zeolite and reverse osmosis methods.
- 2. Compare and contrast corrosion control methods and analyze the performance of alkaline, lead acid and fuel cells.
- 3. Analyze the metal ion concentration for solid and liquid samples with the aid of flame photometry, colorimetry, UV and IR spectroscopy.
- 4. Categorize different types of polymers to select injection or compression fabrication method.
- Analyze the synthesis of nanoparticles using top down and bottom up process. 5.

WATER TECHNOLOGY UNIT 1

Hardness – types, estimation by EDTA method, Boiler troubles – scale, sludge, priming, foaming, caustic embrittlement and boiler corrosion, Internal conditioning - carbonate, phosphate and calgon conditioning, External conditioning – zeolite and demineralisation process, Desalination – reverse osmosis method.

UNIT 2 **ELECROCHEMISTRY AND CORROSION**

Electrochemistry -cell terminology, EMF series. Corrosion - chemical (corrosion by O₂, H₂ and liquid-metal) and electrochemical corrosion (H₂ evolution and absorption of O₂), Corrosion control - sacrificial anode, Impressed current method and electroless plating.

Application of electrochemistry-primary battery (alkaline battery), secondary battery (lead acid battery) and fuel cell (H₂-O₂ fuel cell)

UNIT 3 INSTRUMENTAL METHODS AND ANALYSIS

Basic principles - Beer-lamberts law, instrumentation with block diagram and applications of calorimetry (estimation of Fe²⁺), UV-Visible spectroscopy, infrared spectroscopy and flame photometry (estimation of sodium).

UNIT 4 **HIGH POLYMERS**

Polymers – classification (based on molecular forces-thermoplastics and thermosetting plastics), polymerisation – types, mechanism (Free radical only), Compounding and fabrication - compression, injection, Compositesdefinition, types, polymer matrix composites-FRP only.

Real time applications of thermoplastics (PVC, Teflon), thermosetting plastics (nylon, epoxy resin)

NANOCHEMISTRY UNIT 5

Basics – distinction between molecules, nanoparticles and bulk materials, Nanoparticles – nano cluster, nano rod, nanotube (CNT) and nanowire, Synthesis - top down process (laser ablation and electro-deposition),bottom up process (thermolysis – hydrothermal, solvothermal), Nanoparticles –properties and applications.

TEXT BOOKS:

- 1. P.C Jain and Monika Jain, "Engineering Chemistry", 16thedition, DanpatRai publishing company (P) Ltd, New Delhi.2015.
- 2. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, "Engineering Chemistry", 3rd edition. PHI Learning PVT., LTD, New Delhi, 2014.

REFERENCES:

- S.S.Dara, "A Text book of Engineering Chemistry", 12th Edition, S.Chand& Company Ltd., New Delhi, 2010. 1.
- "Engineering chemistry", 2nd edition, Wiley India private Ltd. New Delhi, 2014. 2.
- V.R.Gowariker, N.V.Viswanathan and Jayadevsreedhar, "Polymer Science" 2nd edition, New age 3. Internationalpublishers, New Delhi, 2015.

Lecture : 45, Tutorial : 0, Total : 45

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- 1. <u>http://nptel.ac.in/courses/113104061/</u>, "Environmental Degradation of Materials" Dr.KallolMondal, Department ofMetallurgy and Material Science, IIT Kanpur.
- 2. <u>http://nptel.ac.in/courses/113105028/</u>, "Science and Technology of Polymers"- Prof.B.Adhikari, Department of Metallurgical & Materials Engineering,IITKharagpur.

21CST13

PYTHON PROGRAMMING (Common to BE / B.Tech. BM, CS, EC, EE, IT & MDE)

Preamble:

Python is easy to use, powerful, and versatile, making it a great choice for beginners and experts alike. Python's readabilit y makes it a great first programming language — it allows you to think like a programmer and not waste time understanding the mysterious syntax that other programming languages can require. The syntax in Python helps the programmers to do coding in fewer steps. Python is widely used in bigger organizations because of its multiple programming paradigms.

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

- Develop algorithms, flowcharts and write Python programs using decision control statements for solving 1. given problems.
- Apply list, set for solving a given problem using functions in python. 2.
- Develop modules and packages for solving problems using tuple and dictionary data structures in python. 3.
- 4. Write python program using string handling features and object-oriented programming concepts
- Identify the essential concepts involved in the design of a database and accessing, manipulating data in the 5. file using SOL. 12

COMPUTING & PYTHON PROGRAMMING UNIT 1

Introduction to digital computer - Problem Solving Strategies: Problem Analysis - Algorithms - Flowcharts -Examples of algorithms and flowcharts- Introduction to Python: Python Overview - Comments - Python Identifiers -Reserved Keywords - Variables - Standard Data Types - Operators - Statement and Expressions -Control Statements - Iteration - While statements - Input from keyboard.

FUNCTIONS, LIST AND SET UNIT 2

Introduction - Built-in functions - Composition of functions - User defined functions - Parameters and Arguments - Function calls - The return statement - Recursive functions - The anonymous functions. Listscreating lists, traversing a list, Deleting elements from list, cloning list, list operations, list methods. Sets-creating sets, set operations.

UNIT 3 **TUPLES, DICTIONARY, MODULES AND PACKAGES**

Tuples- creating tuples, accessing values, tuple assignment, tuple as return values, operations on tuples, built-in tuple functions. Dictionary-creating, accessing, updating, Deleting elements from dictionary, operations and methods. Modules – Packages in Python – Standard library modules.

STRINGS AND OOP CONCEPTS UNIT 4

Strings: String Operations - Compound Data type - len function - String Slices - Strings are immutable - String Traversal - Escape Characters - String formatting operator - String formatting functions. Classes and objects: Overview of OOP - Class definition - creating objects - objects as arguments - objects as return values- Built-in class attributes - inheritance - method overriding - data encapsulation - data hiding.

FILES AND BASIC DATABASE OPERATIONS UNIT 5

File: Types of files - opening, closing, reading and writing files. Purpose of database system - Data model -Creating DB- making table - Adding Data - Querying DB - Database in the real world - Using SQL in Databases -Sorting – Getting unique item - updating records - Deleting records.

TEXT BOOKS:

- E Balagurusamy,— Problem Solving and Python Programming, McGraw Hill Education, 2018. 1.
- Katie Cunningham, —Teach yourself python, Pearson Education, 2014. 2.

REFERENCES:

- 1. Reema Thareja, —Python Programming using Problem Solving Approach, Oxford University Press, 2017.
- Allen B. Downey, -Think Python: How to Think Like a Computer Scientistl, 2nd edition, 2. Updated for Python 3, Shroff/O_Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
- 3. Guido van Rossum and Fred L.Drake Jr, -An Introduction to Python - Revised and updated for Python 3.2, Network theory ltd., 2011.
- John V Guttag, -Introduction to Computation and Programming Using Python, Revised and expanded 4. Edition, MIT Press, 2013.

Lecture : 45, Tutorial : 0, Total : 45

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5. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approachl, Pearson India Education Services Pvt. Ltd., 2016.

- 1. https://swayam.gov.in/course/4178-spoken-tutorial-python-english,
- 2. https://onlinecourses.nptel.ac.in/noc21_cs21, —Programming, Data Structures and Algorithms Using Pythonl, Prof.Madhavan Mukund, IIT-Bombay.

BASIC ELECTRICAL ENGINEERING

Preamble:

21ECT21

Electrical networks, systems and devices are the basic building blocks for today's most complex electrical and electronic systems. It is essential to understand these fundamentals to gain knowledge on solving circuits using network theorems and to obtain the transient responses of AC and DC circuits. As an electronics engineer has to work with many electrical systems, it is relevant to know the functional aspect of machines, wiring and other devices. This course is an introduction to all of them.

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

- 1. Identify and explain the different laws and theorems of electrical circuits.
- 2. Solve for network parameters using various circuit theorems
- 3. Demonstrate the knowledge on transient responses, resonance and coupled circuits.
- 4. Illustrate the construction and operation of motors and transformers.
- 5. Demonstrate the knowledge of the practices of wiring and operation of appliances.

UNIT 1 BASIC CIRCUIT ANALYSIS

Ohm's Law – Kirchhoff's laws – Network Elements- R,L,C-Elements in series and parallel –Mesh and nodal method of analysis for DC and AC circuits – voltage and current sources- Dependent and independent sources-series and parallel connection of independent sources.

UNIT 2 NETWORK THEOREMS FOR DC CIRCUITS

Network reduction: voltage and current division rule, source transformation – star -delta conversion. Thevenin's and Norton's Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem-Duality in circuits.

UNIT'3 AC CIRCUITS

AC passing through pure R, L and C.Frequency response – Series and parallel resonances – Quality factor and Bandwidth - Self and mutual inductances – Dot Convention - Coefficient of coupling-series and parallel connection of coupled coils– Transient response of RL, RC and RLC Circuits using Laplace transform for DC inputs.

UNIT 4 DC MACHINES, TRANSFORMERS AND INDUCTION MOTORS

Construction and Principle of operation of DC Machines – EMF equation of DC Generator –shunt generator– DC motor- speed and torque characteristics of DC series and shunt motors- back EMF- Applications of series and shunt motors. 1 phase and 3 phase AC systems(for sine wave)- phasor notation- Single phase transformer- types: step down, step up, Auto and isolation transformers-Construction and principle of operation of 1 phase squirrel cage induction motors- Construction and operation of Stepper and BLDC Motors.

UNIT 5 ELECTRICAL WIRING AND APPLIANCES

Domestic wiring: Components of Distribution Board -Typical domestic distribution - stair case wiring – types of wires and their rating -Earthing- Fuse ratings –MCB-ELCB- Online UPS- rating of UPS and battery. Fluorescent and LED Lamps – Qualitative approach of Electrical appliances - Ceiling fan, mixie- Compressor, centrifugal and submersible pumps.

TEXT BOOKS:

- 1. Sudhakar A and Shyammohan SP, "Circuits and Networks", McGraw Hill, 5thedn. 2015.
- 2. V.N.Mittle&AravindMittal,"Basic Electrical Engineering",2nd Edition, Tata McGraw Hill,2006.

REFERENCES:

- 1. Monograms prepared by the Faculty of ECE Dept.
- 2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6thedition, New Delhi, 2003.
- 3. Vincent Del Toro, "Electrical Engineering Fundamentals", 2nd Edition, Pearson Edn, 2017. (3rd Reprint).

e-RESOURCES:

- 1. http://www.nptel.ac.in/courses/108108076/1, Basic Electrical technology, Dr. L. Umanand, IISc, Bangalore
- 2. http://nptel.ac.in/courses/108105053/, Electrical Engineering, Prof. G.D. Roy, Prof. N.K. De & Prof. T.K. Bhattacharya ,IITKharagpur.

Lecture: 45, Tutorial: 0, Total: 45

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21PHL11

Preamble:

In the present course related to the lab, understanding of physics concepts applied in optics, thermal and properties of matter has been developed. The necessary practical skills in the determination of water quality parameters and strength of acid has been explored.

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

- 1. Experiment and determine the physical characteristics of given solid materials.
- 2. Experiment and determine the velocity of ultrasonic waves through water medium.
- 3. Experiment and determine the optical property of light sources.
- 4. Experiment and estimate hydroxyl, carbonate and bicarbonate alkalinity using HCl in water sample.
- 5. Experiment and determine the amount of total, temporary, permanent hardness of water using EDTA by complexometric titration.
- 6. Experiment and determine the amount of iron content present in the given sample using potentiometer, spectrophotometer and strength of acid using conductivity meter.

PHYSICS LABORATORY – I (Any Five Experiments)

LIST OF EXPERIMENTS

- 1. (a) Determination of Wavelength, and particle size using Laser.
- (b) Determination of acceptance angle in an optical fiber.
- 2. Determination of velocity of sound and compressibility of liquid Ultrasonic interferometer.
- 3. Determination of wavelength of mercury spectrum spectrometer grating.
- 4. Determination of thermal conductivity of a bad conductor Lee's Disc method.
- 5. Determination of Young's modulus by Non uniform bending method.
- 6. Determination of Planck's constant by photocell method.

CHEMISTRY LABORATORY - I

LIST OF EXPERIMENTS

- 1. Determination of alkalinity in water sample.
- 2. Determination of total, temporary and permanent hardness of water by EDTA method.
- 3. Determination of iron content of the water sample using spectrophotometer (1,10-phenanthroline /thiocyanate method).
- 4. Determination of iron content of the given solution using a potentiometer.
- 5. Determination of strength of acid using conductivity meter.

Lecture : 0, Tutorial : 0, Practical : 30, Total : 30

• Laboratory classes on alternate weeks for Physics and Chemistry.

21CSL13 PYTHON PROGRAMMINGLABORATORY Т С L Р 0

Common to BE / B.Tech. BM, CS, EC, EE, IT & MDE

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Preamble:

Python is a dynamic and powerful programming language that focuses on code readability. The Python language has diversified application in the software development companies such as in gaming, web frameworks and applications, language development, prototyping, graphic design applications, etc. This provides the language a higher plethora over other programming languages used in the industry.

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

- Create documents, presentationslides and perform data manipulations using Libre Office packages. Design 1. flowcharts using Raptor.
- 2. Develop programs using expressions and Control statements in Python.
- Apply suitable data structure in Python for a real-world problem. 3.
- 4. Develop programs using functions, OOP concepts, modules and packages for a given problem.
- Create and manipulate files and database connectivity using Python. 5.

LIST OF EXPERIMENTS

- 1. Creating document, presentation slides and performing mathematical calculations using Libre Office packages.
- 2. Design flowchart using Raptor for the following problems:
 - Solving problems using algorithm and flowchart.
 - To find if a given year is a leap year or not. Any year which is divisible by 4 and not by 100 are leap years. Otherwise, any year which is divisible by 400 is also a leap year.
 - To find the sum of numbers divisible by 4. The flowchart must allow the user to accept a number and add it to the sum if it is divisible by 4. It should continue accepting numbers as long as the user wants to provide an input and should display the final sum.
- 3. Write a python programs for solving the problems:
 - All decision control statements.
 - An organization has decided to provide salary hike to its employees based on their job level. Employees can be in job levels 3, 4 or 5. In case of invalid job level, consider hike percentage to be 0. Given the current salary and job level, write a python program to find and display the new salary for 10 employees in the organization. Hike percentage based on job levels are given below:

Job level	Hike Percentage
3	15
4	7
5	5

- 4. Write a python program to find the list of 'n' prime numbers using functions.
- 5. Write a python program to implement list, set, tuple and dictionary.
- 6. Write a python program by defining a user defined module leap. Import the module and find whether a given year is leap year or not.
- 7. Write a python program to perform the arithmetic operations using packages.
- 8. Write a python Program to implement string handling functions.
- 9. Write a python program to implement object-oriented concepts.
- 10. Write a python program to implement database connectivity.

SOFTWARE

- Python 3 interpreter / open source IDE
- Raptor Tool •
- Libre Office Packages

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45

VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

UNIVERSAL HUMAN VALUES – I

(Common to all B.E/B.Tech Programmes)

Preamble:

21MCL11

Universal Human Values is a life skill necessary for all to develop physical health and factors for strengthening life force. This course aims to expose the students in the areas of mediation and impart the knowledge on social virtues and morals.

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

- 1. Demonstrate the knowledge on physical health
- 2. Discuss the factors for strengthening life force
- 3. Classify mind waves and explain the benefits of meditation
- 4. Explain individual and social virtues
- 5. Identify and explain the importance of morals.

UNIT 1 PHYSICAL HEALTH

SKY – Introduction – Education as a means for youth empowerment – Greatness of Education – Yoga for Youth Empowerment – Simplified Physical Exercises: Explanation – Hand, Leg, Breathing and Eye exercises – Kapalabathi, Makarasanam, Massaging, Acupressure and Relaxation practices –Yogasanas- Explanation – Benefits.

UNIT 2 STRENGTHENING LIFE FORCES

Reasons for Diseases: Natural Reasons (Hereditary, Planetary Position, Natural Calamities and Climatic changes) – Artificial Reasons (Food, Thought, Deed). Philosophy of Kayakalpa: Physical Body –Life Force – Biomagnetism – Mind. Maintaining Youthfulness – Postponing Aging – Transformation of Food into seven Body constituents.

UNIT 3 WELLNESS OF MIND

Classification of Mind Waves – Beta, Alpha, Theeta, Delta – Agna Meditation – Benefits. Shanthi Mediation – Benefits. Thuriya Meditation – Benefits. Blessing and its Benefits: Auto Suggestion – Blessing the family and others – Blessings the World – Divine Protection.

UNIT 4 VIRTUES

Individual Virtues: Self Control – Self Confidence – Speaking Truth – Contentment – Humility – Mind Control. Tolerance – Adjustment – Sacrifice – Forgiveness. Cleanliness (Body, Dress, Surrounding)- External, Mental, Inner Cleanliness. Societal Virtues :Ahimsa – Services, Patriotism – Equality, Respecting the parents and elders – Caring for them – Respecting Teachers. Punctuality – Time Management.

UNIT 5 MORALS

Importance of introspection: I and Mine (Ego, Possessiveness), Six Temperaments: Greed – Anger – Miserliness – Immoral Sexual Passion – Inferior Superior complex – Vengeance. Maneuvering the Six Temperaments: Contentment – Tolerance – Charity – Chastity – Parity – Forgiveness. Five important Benefits of Meditation: Perspicacity – Magnanimity – Adaptability – Receptivity – Creativity. (Enhancing memory) (Effective Examination Preparation).

TEXT BOOKS:

- 1. "Yoga for Youth Empowerment" compiled by Vethathiri Maharishi Institute for Spiritual and Institutional Education, Aliyar, Pollachi, 1st Edition 2016.
- 2. "Yoga for Human Excellence", compiled by Vethathiri Maharishi Institute for Spiritual and Institutional Education, Aliyar, Pollachi 1st Edition 2009.

e-RESOURCES:

1. <u>www.online.vethathiri.edu.in</u> "online in (Virtual) Programme on Yoga and Human Excellence".

Lecture : 30, Tutorial : 0, Total : 30

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VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

21ENT21

COMMUNICATIVE ENGLISH-II

(Common to all B.E/B.Tech Programmes)

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Communicative English-II aims at developing Communication Skills in English essential for expressing the ideas through speaking and writing in different social, academic and professional contexts.

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

- Start, maintain and close a conversation in a variety of contexts including formal/informal and 1. telephonic conversation.
- Use structurally correct expressions and conversations. 2.
- Speak fluently using phrasal verbs and Idiomatic Expressions by recognizing and rectifying own 3. pronunciation and intonation problems.
- Speak fluently using a wide range of vocabulary. 4.
- Communicate effectively by using business correspondence structures. 5.

EFFECTIVE SPEAKING -BASIC LANGUAGE CHUNKS UNIT 1

Conversational Starters - Closing a Conversation - Greeting and Leave Taking - Introducing Oneself -Introducing Others - Making Request - Offering Help - Expressing Gratitude -Extending Invitation - -Conveying Wishes - Encouraging Words -Seeking Permission - Granting Permission-Making Complaints -Seeking Apology - Making Interruption - Expressing Possibility- Expressing Agreement and Disagreement -Expressing Hesitation -Asking for Directions and Giving Directions - Giving Instructions- Questions and Expressions with Time – Checking for Understanding -Showing Interest -Expressing Likes and Dislikes

UNIT 2 EFFECTIVE SPEAKING – ADVANCED LANGUAGE CHUNKS 10 Expressing Personal Opinion - Expressing Feelings - Accepting Responsibility - Giving Clarifications - Tag Questions - Giving Comments - Giving Advice - Making Suggestions - - Making Comparisons - Analyzing Problems- Exploring Options - Making Classifications and Elaborations - Speaking Hypothetically--Discussing Plans-Making Negotiations-Making Presentations-Telephone Etiquette - Telephone Conversation UNIT 3 EFFECTIVE SPEAKING - PHRASAL VERBS AND IDIOMATIC EXPRESSIONS 3

Most useful Phrasal Verbs related to Self-Introduction-Idiomatic Expressions related to Person, Time and Action.

EFFECTIVE SPEAKING – VOCABULARY ENRICHMENT UNIT 4

Talking about Abilities – Travel – Shopping – Climate -Commuting – Distance – Food – Occupation – Parties and Festivals - Daily Routine - Clothing - Hobbies - Favorites- Family - Buying and Selling-Schedules and Plans

UNIT 5 BUSINESS WRITING

Writing Instructions - Recommendations - Checklist - Tour Itinerary -Writing Slogans - E- mail Writing -Single Line Definitions - Process Description - SMS - Transcoding Graphics - Bar Chart, Flow Chart, Pie Chart and Tables - Business Letters - Calling for Quotations, Placing Orders, Letter of Complaint, Letter of Clarification - Agenda and Meeting Minutes - Cover Letter with Résumé - Report Writing - Accident Report, Industrial Visit Report, Survey Report and Feasibility Report- Summary Writing.

TEXT BOOKS:

- Sanjay KumarandPushp Lata, "Communication Skills" 2nd Edition, Oxford University Press, New 1. Delhi.2017.
- 2. J.K.Gangal, "A Practical Course in Spoken English" 1st Edition PH1 Learning Private Limited, Delhi.2014.

REFERENCES:

Dr K Elango, Dr. Veena Selvam, Dr. Sujatha Priyadarshini, "Resonance English for Engineers and 1. Technologists". Cambridge University Press, 1st Edition, Foundation Books, New Delhi, 2013.

Lecture : 45, Tutorial : 0, Total : 45

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- 2. Dr.MahendraSarawat, "Speak English Fluently" UpkarPrakashan Publishers, 1st Edition, Agra, 2010.
- 3. S.Sumant, Joyce Pereira, "Technical English", Vijay Nicole imprints Private Limited, 1st EditionChennai, 2017.

- 1. https://www.fluentu.com/Blog/english/english-small-talk/
- 2. http://www.britishcouncil.com

21MAT21

Preamble:

Vector calculus is a form of mathematics that is focused on the integration of vector fields. An Engineer should know the Transformations of the Integrals, as Transformation of Line Integral to surface and then to volume integrals. Complex Integration approach is very useful to evaluate many improper integrals of a real variable. The Laplace transform method is a powerful method for solving linear ODEs and corresponding initial value problems as well as systems of ODEs arising in Engineering. The knowledge of transformations is to create a new domain in which it is easier to handle the problem that is being investigated.

ENGINEERING MATHEMATICS – II

(Common to all B.E/B.Tech Programmes)

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

- 1. Compute gradient, directional derivative by vector differentiation and determine line integrals, surface integrals and volume integrals by vector integration.
- Construct analytic functions and transforms the analytic functions from one domain to another using 2. conformal mapping.
- 3. Classify the singularities, find Laurent's series for analytic functions and compute complex integrals using Cauchy's integral theorem and Cauchy's Residue theorem.
- 4. Solve linear higher order differential equations with constant and variable coefficients
- 5. Solve linear second order ordinary differential equations with constant coefficients using the properties of Laplace Transforms.

UNIT 1 **VECTOR CALCULUS**

Vector Differentiation: Gradient, divergence and curl - Directional derivative - Irrotational and Solenoidal vector fields - Vector integration: Line, Surface and Volume Integrals -Green's theorem in a plane, Gauss Divergence theorem and Stokes' theorem (excluding proofs) - Simple applications involving squares, rectangles, cubes and rectangular parallelepipeds.

ANALYTIC FUNCTIONS UNIT 2

Functions of a complex variable - Analytic functions: Necessary conditions - Cauchy-Riemann equations and sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic function - Harmonic conjugate - Construction of analytic functions by Milne's method - Conformal mapping:

w = z+k, kz, 1/z and bilinear transformation.

UNIT 3 **COMPLEX INTEGRATION**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proof) – Taylor's and Laurent's series expansions - Singularities - Residues - Cauchy's residue theorem(excluding proof) -Application of residue theorem to evaluate real definite integrals as contour integrals around unit circle and semicircle (excluding poles on the real axis)

UNIT 4 **ORDINARY DIFFERENTIAL EQUATIONS**

Linear higher order differential equations with constant coefficients - Method of variation of Parameters - Cauchy's and Legendre's linear differential equations - Simultaneous first order linear differential equations with constant coefficients.

UNIT 5 LAPLACE TRANSFORMS

Laplace transform: Sufficient conditions - Transform of elementary functions - Basic Properties - Transforms of derivatives and integrals of functions - Transform of periodic functions. Inverse Laplace transform: Standard results - Statement of Convolution theorem and its applications - Initial and final value theorems - Solution of linear second order ODE with constant coefficients using Laplace transformation techniques.

TEXT BOOKS:

- 1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, New Delhi, 2014.
- 2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 26th Reprint, New Delhi, 2016.

REFERENCES:

- Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016. 1.
- Veerarajan T., "Engineering Mathematics (I Year)", 3 rd Edition, Tata McGraw Hill Publishing Company, 2. Delhi, 12

Lecture: 45, Tutorial: 15, Total: 60

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3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, "Higher Engineering Mathematics", S.Chand & Co Ltd, Chennai, 2016.

- 1. http://nptel.ac.in/courses/122107036/ "Mathematics-II", Prof. Tanuja Srivastava, Department of Mathematics, Indian Institute of Technology, Roorkee.
- http://nptel.ac.in/courses/122107037/ "Mathematics III", Prof. Dr. P. N. Agrawal, Indian Institute of Technology, Roorkee

BIOCHEMISTRY

Preamble:

Biomedical Engineering is an interdisciplinary course. Biochemistry is to provide grounding in the basic principles of Life Sciences. The course provides a description of the principal biochemical components of cells and demonstrates how energy is produced, converted and stored in cell and then released into highenergy compounds capable of driving biochemical reactions. The course educates basic chemical properties of molecules and how these properties relate to specific macromolecular structures and functions and imparts knowledge in principle, instrumentation and applications of bioanalytical techniques used for the separation of biomolecules.

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

- Apply the fundamental knowledge of chemistry and biology to solve biochemical problems. 1.
- 2. Identify the levels of structure in Proteins, Lipids, Nucleic acids and Carbohydrates and the stabilization factors of these structures
- 3. Describe the structure, mechanism, catalysis, activity, assay techniques and kinetics of enzymes in biochemical pathways
- Analyze the bioenergetics, kinetics and hormone regulation of the metabolic pathways. 4.
- Calculate the energy yield from the catabolism of any biomolecule. 5.

INTRODUCTION TO BIOCHEMISTRY UNIT 1

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson-Hasselbalch equation, physiological buffers-phosphate buffer, bicarbonate buffer, heamoglobin buffer, fitness of the aqueous environment for living organism . Principle and biological applications of viscosity, surface tension, adsorption, diffusion and osmosis. Important noncovalent forces – Hvdrogen bonds, electrostatic, hydrophobic & vanderwaals forces.

UNIT 2 **CARBOHYDRATES**

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. 9

UNIT 3 LIPIDS

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 and ketogenesis. Transport of lipids. Structural architecture and significance of biological membrane.

NUCLEIC ACID & PROTEIN UNIT 4

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, chargoffs 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.

ENZYME AND ITS KINETICS UNIT 5

Classification of enzymes, apoenzyme, coenzyme, holoenzyme and cofactors. Kinetics of enzymes -Michaelis- Menten equation and Lineweaver- burk 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.

Lecture : 45, Tutorial : 0, Total : 45

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21BMT21

TEXT BOOKS:

- 1. Biochemistry, U.Satyanarayana, Arunabha Sen Books and Allied (p) Ltd, Kolkatta, 2005, Second Edition.
- 2. Harper's Illustrated Biochemistry By Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Twenty-sixth edition, International Edition, McGraw-Hill, 2003.

REFERENCES:

- 1. David L Nelson, Michael M Cox, Albert L Lehninger "Lehninger principles of biochemistry", New York: W.H. Freeman, 2006.
- 2. Medical Biochemistry, N.V.Bhagavan, Fourth edition, Academic Press An Imprint of Elsevier, 2004

e-RESOURCES:

1. https://youtu.be/jLyi2K-29xU, "Biochemistry-1", Professor S. Dasgupta, Department of Chemistry, IIT, Kharagpur

HUMAN ANATOMY AND PHYSIOLOGY

Preamble:

21BMT22

The prime concern of this syllabus is to integrate the individual functions of all the cells and tissues and organs into functional whole, the human body. Since function is dependent on a structure, the curriculum lays stress on functional anatomy of the organs. The course therefore emphasizes on the cardiovascular, respiratory, urinary and nervous system and their interrelatedness. Most of the topics are of introductory level and would stimulate the students to understand the basic functioning of every system and the resultant unified organization.

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

- 1. Identify and explain basic elements of human body
- 2. Explain the functions of skeletal and respiratory system
- 3. Describe the structure and function of cardiovascular system
- 4. Discuss the structure of urinary and special sensory system
- 5. Describe the physiological process of Nervous and Gastrointestinal system

UNIT 1 BASIC ELEMENTS OF HUMAN BODY

Cell – Cell Structure and organelles - Functions of each component in the cell. Cell membrane –transport across membrane - Action potential (Nernst, Goldman equation), Homeostasis. Tissue: Types, functions

UNIT 2 RESPIRATORY AND MUSCULOSKELETAL SYSTEM

Respiratory System: Components of respiratory system – Respiratory Mechanism. Types of Respiration - Oxygen and carbon dioxide transport- Acid base regulation–Types of muscles – Structure and Properties of Skeletal Muscle- Changes during muscle contraction- Neuromuscular junction.

UNIT 3 CARDIOVASCULAR SYSTEM

Blood - composition - functions of blood - RBC , WBC types and their functions- Blood groups-identification of blood groups - Structure of heart – Blood vessels - Properties of Cardiac muscle – Conducting system of heart – Cardiac cycle – Heart sound – ECG - Volume and pressure changes and regulation of heart rate –Coronary Circulation

UNIT 4 URINARY AND SENSORY SYSTEM

Urinary system: Structure of Kidney and Nephron. Mechanism of Urine formation and acid base Regulation – Micturition reflex –. Special senses: Eye and Ear.

UNIT 5 NERVOUS SYSTEM AND GASTERO INTESTINAL SYSTEM

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. Autonomic nervous system and its functions. Introduction to digestive system-Mouth and salivary glands-Stomach-pancreas-liver and Gall bladder- Small, large intestines.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

1. K.Sembulingam, Premasembuligam," Essentials of Medical Physiology"Jaypee Brothers Medical Publishers (P) Ltd New Delhi, Sixth Edition ,2012.

REFERENCES:

- 1. Arthur C, Guyton, John Hall.E "Textbook of Medical Physiology", W.B.Saunders Company, Twelfth edition, 2006.
- 2. Ranganathan T S, "Text Book of Human Anatomy", Chand S, & Co. Ltd., Fifth Edition, 1996.
- 3. SaradaSubramanyam,MadhavanKutty. K and Singh. H.D, "Text Book of Human Physiology"– Chand. S, & Company, First Edition, 1996.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/107103004/7 , "Human physical dimension concern",Prof.Mainak Das,IIT Kanpur.
- 2. http://nptel.ac.in/courses/122103039/14, "Nervous System", Prof. Mainak Das, IITK anpur.

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21BMT23

Preamble:

Medical Physics is an applied branch of Physics concerned with the application of the radiation concepts and methods of Physics in Medical science. This course accentuates the principle, effects and clinical applications of ionizing, non-ionizing and electromagnetic radiation. This also enunciates the fundamentals of acoustic waves and their interaction with human tissues.

MEDICAL PHYSICS

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

- 1. Interpret the properties of electromagnetic radiations and its effect on human.
- 2. Describe the principles and production of radioactive nuclides.
- 3. Explain the interaction of radiation with matter.
- 4. Identify and explain the radiation quantities and its effects

5. Demonstrate the knowledge on the properties of sound and its application in medicine.

UNIT 1 LOW ENERGY ELECTROMAGNETIC SPECTRUM AND ITS MEDICAL

APPLICATION

Physics of light, Intensity of light, limits of vision and color vision an overview, Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects-Tissue as a leaky dielectric-Low Frequency Effects- Higher frequency effects., Thermography– Application.

UNIT 2 PRINCIPLES OF RADIOACTIVE NUCLIDES

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 Radionuclide-fission and neutron capture reaction, radionuclide Generator-Technetium generator.

UNIT 3 INTERACTION OF RADIATION WITH MATTER LIPIDS

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 4 RADIATION DOSE AND ITS EFFECTS

Dose and Exposure measurements – Units (SI), Inverse square law, Maximum permissible exposure, relationship between the dosimetric quantities, Radiation biology – effects of radiation, concept of LD 50, Stochastic and Non-stochastic effects, Radiation Syndrome.

UNIT 5 PRINCIPLES AND APPLICATIONS OF SOUND IN MEDICINE

Physics of sound, Normal sound levels, ultrasound fundamentals, Generation of ultrasound (Ultrasound Transducer), Interaction of Ultrasound with matter- Cavitations, Reflection, Transmission, Scanning methods, Artifacts, Ultrasound- Doppler effect, Clinical Applications.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

1. B.H. Brown, R.H. Smallwood, D.C. Barber, P.V. Lawford, D.R. Hose, —Medical Physics and Biomedical Engineeringl, Institute of physics publishing, Bristol and Philadelphia, 1999. (Unit 1,4,5)

2. Gopal B. Saha — Physics and Radiobiology of Nuclear Medicinell Third edition Springer, 2006. (Unit 2,3,4) **REFERENCES:**

- 1. W.J. Meredith and J.B. Massey —Fundamental Physics of Radiology Varghese Publishing house. 1992.
- 2. Steve Webb, The Physics of Medical Imaging, Taylor & Francis, Newyork, 2010.
- 3. R.S. Khandpur, —Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2003.

e-RESOURCES:

- 1. http://www.nptel.ac.in/courses/115102017/, "Nuclear science and Engineering", Dr. Santanu Gosh, Department of Physics, IIT, Delhi.
- 2. http://www.uthgsbsmedphys.org/GS02-0093/ ," Introduction to Medical Physics II", Dr George Starkschall, The University of Texas at Houston.

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21MEC11

Preamble:

The knowledge of Engineering graphics is essential for the Engineering graduates in proposing new product designs through drawings and interpreting data from existing drawings. Engineering Design inculcates into an Engineer the creativity and knowledge on various aspects to be considered while designing and realizing the functional products and processes. This course deals with Engineering curves, orthographic and pictorial projections, sectional views and development of surfaces.

ENGINEERING GRAPHICS

(Common to all B.E/B.Tech Programmes)

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

- Draw the various conic sections and Engineering curves. 1.
- Sketch the orthographic views from given pictorial views and projections of lines. 2.
- Draw the projections of planes and solids kept in various positions. 3.
- 4. Sketch sectioned views of solids and development of surfaces.
- 5. Draw the isometric and perspective projections of simple solids.

INTRODUCTION AND PLANE CURVES UNIT 1

Importance of graphics in Engineering applications - Use of drafting instruments - BIS conventions and specifications – Size, layout and folding of drawing sheets – Lines, lettering and dimensioning-Basic geometrical constructions. (PRACTICE ONLY AND NOT FOR EXAMINATIONS).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.

PROJECTION OF POINTS, LINES AND FREE HAND SKETCHING UNIT 2

Orthographic projection- principles-Principal planes-First angle projection- Projection of points in four quadrants -End point 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. Visualization concepts- Free hand sketching - Conversion of Isometric view to orthographic views.

PROJECTION OF PLANE SURFACES AND SOLIDS UNIT 3

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. Projection of simple solids- Cube, prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane and parallel to the other by rotating object method.

UNIT 4 SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Sectioning of above solids in simple vertical position when cut by a cutting plane which is inclined to one of the reference planes and perpendicular to the other - Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids in simple vertical position – Cube, prisms, pyramids, cylinder and cone. 9+3

ISOMETRIC AND PERSPECTIVE PROJECTIONS UNIT 5

Principles of isometric projection – Isometric scale –Isometric projections of simple solids - Prisms, pyramids, cylinder and cone- Combination of two solid objects in simple vertical position. Perspective projection of simple solids-Cube, prisms, pyramids, cylinder and cone, by visual ray method when axis is either parallel or perpendicular to ground plane.

TEXT BOOKS:

- Venugopal K and Prabhu Raja V., "Engineering Graphics", New Age International (P) Ltd, 13th 1. Edition.2015.
- Jeyapoovan T., "Engineering Graphics with AUTOCAD", Vikas Publishing House Pvt., Ltd., 7th 2. Edition.2015.

REFERENCES:

- Bhatt N.D., Panchal, V.M. and Ingle P.R., "Engineering Drawing", Charotar Publishing House Pvt. Ltd., 1. 53rd Edition.2014.
- Parthasarathy N.S. and Vela Murali, "Engineering Drawing", Oxford University Press, 1st Edition, Second 2. 2015.

Lecture: 45, Practical: 15, Total: 60

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3. LuzzaderW..J. and Duff J.M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/105104148, "Engineering Graphics" Dr. NiharRanjanPatra , IIT Kanpur.
- 2. http://cfd.annauniv.edu/webcontent.htm, "Engineering Graphics" Dr. Velamurali.

21PHL21

Preamble:

The understanding of characteristics of solids and liquids and properties of semiconducting materials has been explored. The practical skills in the instrumental methods for quantitative estimation of metal ions content has been the main focus.

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

- 1. Experiment and determine the physical characteristics of given solid material.
- 2. Experiment and determine the Energy band gap of the given semiconducting materials.
- 3. Experiment and determine the physical characteristics of given liquid.
- 4. Experiment and estimate dissolved oxygen content using alkali iodide solution by Winkler's method, amount of copper content using EDTA by complexometric titration.
- 5. Experiment and test chloride content present in the waste water by titrating against silver nitrate using Mohr's method.
- 6. Experiment and determine the concentration of metals and ions present in the waste water with the aid of flame photometer and pH meter.

PHYSICS LABORATORY – II (Any Five Experiments)

LIST OF EXPERIMENTS

- 1. Determination of Young's modulus by uniform bending method.
- 2. Determination of band gap of a semiconductor.
- 3. Determination of coefficient of viscosity of a liquid Poiseuille's method.
- 4. Determination of thickness of a thin wire Air wedge method.
- 5. Determination of rigidity modulus Torsion pendulum.
- 6. Determination of Hysteresis of a ferromagnetic material –Deflection magnetometer

CHEMISTRY LABORATORY – II

LIST OF EXPERIMENTS

- 1. Determination of Dissolved Oxygen content of waste water sample by Winkler's method
- 2. Determination of chloride content of wastewater sample by Argentometric method.
- 3. Determination of acid strength in waste water using pH meter.
- 4. Estimation of dissolved metal ions present in wastewater using flame photometer.
- 5. Estimation of dissolved metal ions(copper) present in wastewater by EDTA method.

Lecture : 0, Tutorial : 0, Practical : 30, Total : 30

• Laboratory classes on alternate weeks for Physics and Chemistry.

21MEL11

WORKSHOP PRACTICES LABORATORY

(Common to all B.E/B.Tech Programmes)

Preamble:

Workshop practices give hands-on training practice to Engineering students. This course includes carpentry, plumbing, welding, sheet metal forming and welding exercises. Also, this course will inculcate in the students the habit of selecting right tools, planning the job and its execution.

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

- 1. Fabricate various joints by carpentry and to prepare plumbing line assemblies.
- 2. Fabricate various joints through arc welding and gas welding processes.
- 3. Perform metal forming and basic machining operations.
- 4. Construct various types of domestic wiring and measure the various electrical parameters.
- 5. Develop and test circuits with active elements and verify truth table of logic gates.

GROUP A CIVIL

Plumbing Works:

- Study of plumbing tools, pipeline joints, its location, functions and safety aspects.
- a. Distribution of water from sump to overhead tank and return to home tap with bye pass connection.
 b. Distribution of water in mixed pipes.

Carpentry using Power Tools only:

• Study of the carpentry tools, joints and processes in roofs, doors, windows and furniture and safety precautions.Hands-on-exercise:

- 1. Tee Lap joint
- 2. Dove tail joint

MECHANICAL

Welding:

- 1. Arc welding Lap joint
- 2. Arc welding Tee joint

Basic Machining:

- 3. Simple Turning and Facing
- 4. Drilling and Tapping

Sheet Metal Work- Forming & Bending:

5. Model making - Tray / Funnel

Study Experiments:

- (a) Study of centrifugal pump
- (b) Study of air conditioner

Demonstration:

Gas welding practice

GROUP B

ELECTRICAL

- 1. Residential house wiring using switches, fuse, indicator and lamps.
- 2. Fluorescent lamp wiring.
- 3. Stair case wiring.
- 4. Reading of voltage, current, power, energy and other parameters with 1 phase digital energy meter.
- 5. Measurement of earth resistance.

ELECTRONICS

- 1. Identification and Study of Electronic components and equipments Resistors, capacitors, inductors, colourcoding and measurement.
- 2. Measurement of AC signal parameters (peak-peak, RMS value, period, frequency) using CRO.
- 3. Verification of the truth tables of logic gates: AND, OR, XOR and NOT.
- 4. Construction of Half Wave and Full Wave Rectifiers and study their output waveforms.

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5. Soldering practice – Using general purpose PCB.

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45 REFERENCES: Manual prepared by the faculty of Mechanical Engineering Department, VCET. e-RESOURCES: http://vlabs.iitkgp.ernet.in/be/#

21BML21 BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY L T P C 0 0 2 1

Preamble:

Biochemistry and Human physiology Laboratory is structured to train the students in clinical laboratory analysis concerned with the diagnosis, treatment and prevention of diseases. A Biomedical Engineer need to know these tests for analyzing body fluids, tissues, blood typing, chemical analyses, cell counts of blood, system and organ functions etc.

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

- 1. Experiment and Identify the chemical and microscopic components of biological samples under different physiological conditions.
- 2. Experiment and quantify the abnormal constituents in biological samples and interpret common result patterns related to different pathological conditions.
- 3. Perform physiological tests that examine the function of various components of a body system.
- 4. Experiment and study steady state kinetics of clinically important enzymes.
- 5. Use common analytical instruments in clinical laboratory

LIST OF EXPERIMENTS

- 1. General tests for carbohydrates, proteins and lipids.
- 2. Estimation of blood glucose.
- 3. Estimation of creatinine
- 4. Estimation of urea
- 5. A virtual spectrophotometer: Measuring NADH oxidation by pyruvate and the free energy change that take place during the reaction
- 6. Virtual analysis: Effect of Substrate Concentration on Enzyme Kinetics || Effect of temperature on enzyme kinetics
- 7. Separation of amino acids by thin layer chromatography
- 8. ESR, PCV, MCH, MCV, MCHC, total count of RBCs and hemoglobin
- 9. Ishihara chart for color blindness and Snellen's chart for myopia and hyperopia –by letters reading and ophthalmoscope to view retina.
- 10. Weber's and Rinne's test for auditory conduction.

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45

REFERENCE:

1.Wilson, K., Walker, J "Principles and Techniques of Practical Biochemistry" (5th Ed.).; Cambridge University Press, Cambridge, 2000.

21MAT31

TRANSFORMS AND PARTIAL DIFFERENTIAL **EOUATIONS**

С L Т Р 3 1 0 4

(Common to B.E./B.Tech. BM, EC, EE, IT, Civil, Mechanical, MD programmes in

Third Semester)

Preamble:

The phenomena of heat conduction, wave and signal propagation in media are described by Partial Differential equations (PDE) or Difference equations. For analyzing such phenomena, knowledge of mathematical techniques for solving PDE and Difference equations are needed for engineering students. This course aims to provide sufficient knowledge to engineering students in the specific mathematical techniques such as Fourier series, Fourier transform, Ztransform and PDE.

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

- Compute the trigonometric form of the Fourier series for periodic waveforms satisfying the Dirichlet's conditions 1. and using them to evaluate infinite series.
- 2. Compute the solution for the standard forms of linear partial differential equations of first order and solve homogeneous partial differential equations of first and second order with constant coefficients.
- 3. Compute the analytical solution for the given physical model for the specified initial and boundary conditions in one dimensional and two dimensional distributions.
- Compute the Fourier transform of elementary non-periodic waveforms using Fourier Transform properties. 4.
- Solve the difference equations of first and second order using Z-transform techniques. 5.

FOURIER SERIES UNIT 1

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range sine series - Half range cosine series - Parseval's identity - Harmonic Analysis.

PARTIAL DIFFERENTIAL EOUATIONS UNIT 2

Formation of partial differential equations - Singular Integrals - Solutions of standard types of first order partial differential equations: F(p, q) = 0, F(z, p, q) = 0, F(x, p) = G(y, q) and z = px + qy + F(p, q) - Lagrange's linear equation- Linear partial differential equations of second and higher order with constant coefficients ofhomogeneous type.

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS UNIT 3

One dimensional wave equation – Transverse vibrations of a string – One dimensional equation of heat conduction – Steady state temperature distribution in a rod – Two dimensional steady state temperature distributions in a plate. 9+3

UNIT 4 FOURIER TRANSFORMS

Statement of Fourier integral theorem - Fourier transform pair - Fourier sine and cosine transforms - Properties -Convolution theorem - Parseval's identity.

Z TRANSFORMS AND DIFFERENCE EQUATIONS UNIT 5

Z-transforms - Elementary properties - Inverse Z-transform (using Partial Fraction and Residues) - Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

Lecture : 45, Tutorial : 15, Total : 60

TEXT BOOKS:

- Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, University Press India (P) 1. Ltd, Hyderabad, 2015.
- Grewal, B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna publishers, Delhi, 2016. 2.

REFERENCES:

- Ramana.B.V., "Higher Engineering Mathematics", First edition, Tata Mc-GrawHill Publishing Company 1. limited, New Delhi, 2016.
- 2. Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth edition, Wiley Dream Tech India (P) Ltd., 2016.
- Babu Ram, "Engineering Mathematics", Second edition, Vol.2, Dorling Kindersley India (P) Ltd, Licenses of 3. Pearson Education in South Asia, 2012.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/111105035/27 , "Advanced Engineering Mathematics", Prof. Jitendra Kumar, Department of Mathematics, Indian Institute of Technology, Kharagpur.
- 2. http://nptel.ac.in/courses/111106046, "Fourier Series", Prof.R.Radha, and Prof S. Thangavelu, Department of Mathematics, Indian Institute of Technology Madras, Chennai.

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21ECT31

SIGNALS AND SYSTEMS (Common to EC, BM and MDE programmes)

Preamble:

Signals and systems concerns with analysis and synthesis of deterministic signals and their interaction with LTI systems. The analysis of Signals and its concepts play a vital role in signal processing, image and video processing and digital/analog communications. In order to understand the analysis of signals in the frequency domain it is essential to learn Fourier analysis, Laplace and Z transforms. The discrete time version of a signal is needed to make a filtering and further processing of a signal.

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

- Verify the linearity, stability, causality and time invariance properties of CT and DT systems. 1.
- 2. Compute the frequency spectrum of the periodic CT signals using Fourier series and aperiodic CT signals using Fourier & Laplace transforms.
- 3. Realize the Direct Form I & II structures of the given LTI-CT systems and compute the impulseresponse.
- 4. Determine the frequency response of the given DT sequences using Z transform and DTFT.

Develop the Direct Form I & II structures of the given LTI-DT systems and determine the impulseresponse. 5.

CLASSIFICATION OF SIGNALS AND SYSTEMS UNIT 1

Continuous time signals - Discrete time signals - Impulse, Step, Ramp, Parabolic, Sinusoidal, Exponential, Pulse -Operations on Signals – Classification of CT and DT signals: Deterministic & Random signals, Periodic & Aperiodic signals, Energy & Power signals, Causal & Non-causal, Even & Odd signals - CT systems and DT systems -Classification of systems: Static & Dynamic, Linear & nonlinear, Time-variant & Time-invariant, Causal & non-causal, Stable & unstable.

ANALYSIS OF CONTINUOUS TIME SIGNALS UNIT 2

Fourier series (Trigonometric and Exponential) – Spectrum of Continuous Time (CT) signals – Properties of Laplace Transform - Fourier and Laplace Transforms in CT signal analysis.

LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS UNIT 3

Differential Equations – Impulse response – Block diagram representation – Realization using Direct form I, Direct form II - Convolution integrals - Fourier and Laplace transforms in analysis of CT systems - Introduction to SCILAB -CT Signal Modeling using Scilab.

UNIT 4 ANALYSIS OF DISCRETE TIME SIGNALS

Sampling theorem – DTFT and Inverse DTFT – Z and Inverse Z Transform – Properties of Z Transform – DT Signal Analysis using Scilab.

UNIT 5 LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS

Difference equations - Impulse response - Block diagram representation - Realization using Direct form I, Direct form II - Convolution sum - DTFT and Z Transform analysis of Recursive & Non-Recursive systems - System Analysis using Scilab.

TEXT BOOKS:

- 1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson Education, India, 2ndEdn, reprint 2015.
- P.RameshBabu and R.Anandanatarajan, "Signals and Systems", Scitech Publication, 2014. 2.

REFERENCES:

- B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009. 1.
- 2. M.J.Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw Hill, 2nd Edition.2010.
- 3. A.Nagoorkani, "Signals and Systems", McGraw Hill, Second Edition, 2010.

e-RESOURCES:

- http://www.nptel.in/courses/117101055, "Signals and systems", Prof.V.M.Gadre, IIT Bombay. 1.
- 2. http://www.nptel.in/courses/117104074, "Signals and systems", Prof.K.S.Venkatesh, IIT Kanpur.
- http://www.scilab.org 3.

Lecture: 45, Tutorial: 15, Total: 60

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21BMT31

Preamble:

The purpose of course is to provide guidelines to interpret and correlate clinical and laboratory data so that clinical manifestations of diseases can be explained. Diagnose routine and complex clinical problems on the basis of histopathology and cytopathology. Microbiology deals with study of microscopic organisms that include bacteria, algae, protozoa, fungi and protozoa and their complex mechanism. They study the laboratory techniques used for characterizing the microorganism and body's defense system (immune system) against various pathogens.

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

- 1. Relate the essential basic pathological processes to the pathogenesis of common and important diseases.
- 2. Correlate the important clinical features of the disease with the pathologic changes.
- 3. Analyze the etiology, pathogenesis, gross and microscopic appearances, relevant laboratory investigations, complications and the outcome of common diseases.
- 4. Elucidate the role of physiological system in maintaining homeostasis, challenging infections and fighting cancer.
- 5. Identify the characteristics of various microbes with regard to infection by using modern techniques.

UNIT 1 CELL DEGENERATION, REPAIR AND NEOPLASIA

Cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification, cellularadaptations of growth and differentiation, Inflammation and Repair - fracture healing, Neoplasia-Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours.

UNIT 2 HEMODYNAMIC AND HEMATOLOGICAL DISORDERS

Edema, normal hemostasis, hemorrhage, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock. Hematological disorders-Bleeding disorders, Leukaemias, Lymphomas.

UNIT 3 MICROSCOPY AND MICROORGANISM

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Morphology and Physiology of bacteria and virus.

UNIT 4 MICROBIAL CULTURES AND STAINING TECHNIQUES

Sterilization and disinfection, Culture media and its types, culture techniques and observation of culture, Bacterial growth curve, identification of bacteria. Staining methods – simple, gram staining and AFB staining.

UNIT 5 IMMUNOLOGY

Immune response -Natural and artificial immunity, opsonization, phagocytosis, monoclonal antibodies, hypersensitivity reactions, antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, Disease caused by bacteria, fungi and virus.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. Vinay Kumar, AbulK.Abbas, "Robbins and Cotran Pathologic Basis of Diseases", 7th edition, Elsevier, 2006.
- 2. Ananthanarayanan and Paniker's, "Textbook of Microbiology" Orient Longman Private Limited, 7th edition, 2005.

REFERENCES:

- 1. BN Datta, "Text book of Pathology", Jaypee Medical Publications, 2nd edition, New Delhi, 2004.
- 2. Michael J. Pelczar, JR., E.C.S. Chan and Noel R. Kries "Microbiology", Tata McGraw-Hill, New Delhi, 5th edition, 2006.
- 3. Kathleen Park Talaro, "Fundamentals of Microbiology", McGraw Hill Higher education, 5th Edition 2005.

e-RESOURCES:

- 1. Microbiology and Immunology On -line from the Department of Pathology, Microbiology and Immunology at the University of South Carolina School of Medicine, http://pathmicro.med.sc.edu/book/welcome.htm comprehensive list of lectures, quizzes and other learning material.
- 2. http://emedicine.medscape.com/infectious_diseases (very comprehensive website listing numerous infectious disease agents, with background, differential diagnoses, treatment and follow up)
- 3. http://onlinevideolecture.com/?course_id=700&lecture_no=21, "Introduction to Microbiology", Prof. Venkobachar, IIT, Chennai.

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VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

21BMT32

Preamble:

To develop the understanding of measurement systems, the characteristics of instruments and to classify transducers to identify the biomedical applications. To understand the signal conditioning principles and to describe the display/recording devices.

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

- 1. Describe the purpose and methods of measurements and the errors associated with measurement.
- 2. Identify the biomedical applications of passive and active transducers using their principles of operation.
- 3. Explain the biomedical applications of photoelectric and piezoelectric transducers using their principles of operation.
- 4. Interpret the principles of signal conditioning and signal analyzers.
- 5. Illustrate the performance and characteristics of display and recording devices.

UNIT 1 MEASUREMENT SYSTEM AND BASICS OF TRANSDUCER

Measurements: Significance of measurements – Methods of measurements, Instrumentation – classification of instruments – Functions of instruments and measurement systems – applications of measurement systems, Elements of a generalized measurement systems, Static characteristics, Dynamic characteristics, Errors in measurement, calibration, standards and their classification, Classification of transducers.

UNIT 2 MEASUREMENT OF NON-ELECTRICAL QUANTITIES

Strain gauges: gauge factor-Types of strain gauges- Biomedical applications-strain gauge as displacement and pressure transducers, transducer: capacitive: capacitance measuring circuits -biomedical applications, Inductive: LVDT-Biomedical applications, Passive types: Thermoresistors- thermistor - biomedical applications , Active type: Thermocouple - biomedical applications.

UNIT 3 OPTICAL AND PIEZO ELECTRIC SENSORS

Photo emissive tubes- Photo Multiplier Phototube (PMT)-scintillation counter-photovoltaic and junction diodes-Photo conductive cells-phototransistor- comparison of photoelectric transducers-spectro photometric applications of photo electric transducers, Piezoelectric transducers- modes of operation of piezoelectric crystals- uses of piezoelectric materials and transducers, biomedical applications as ultrasound transducers.

UNIT 4 SIGNAL CONDITIONING & SIGNAL ANALYSER

DC Bridges – Wheat stone bridge – Kelvin – Kelvin double bridge, AC Bridges- Maxwell – Hay – Schering, Anderson's ,Signal analyzer: Wave- Spectrum- Harmonic Distortion analyzer.

UNIT 5 DIGITAL DATA DISPLAY AND RECORDING SYSTEM

Digital voltmeter, Multi meter, CRO and DSO, Graphic recorders-strip chart, X-Y recorder, Magnetic tape recorder, photographic recorder, inkjet recorder, Thermal array recorder.

TEXT BOOKS:

- 1. Sawhney A.K., "A course in electrical and electronic measurements and instrumentation", DhanpatRai& Co (P) Ltd, Educational and Technical Publishers, Reprint 2015.
- 2. L.A Geddas and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wileyand Sons, 3rd Edition, Reprint 2008.

REFERENCES:

- 1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2nd Edition 2014.
- 2. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 3rdEdition 2007.
- 3. Albert D Helfrick, William D Cooper, "Modern Electronic Instrumentation and Measurement techniques "PHI Learning Private Limited, New Delhi, 2011.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/112103174/3, Sensors and Transducers by Prof. AlokBarua, IIT, Kharagpur.
- 2. http://nptel.ac.in/courses/108105064/1, Classification of Instruments by Prof. AlokBarua, IIT, Kharagpur.
- 3. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html,Piezoelectric sensors by Prof. AlokBarua, IIT Kharagpur.

Lecture: 45, Tutorial: 0, Total: 45

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21BMT33

SEMICONDUCTOR DEVICES

Preamble:

The invention of solid state diodes and transistors has revolutionized the world. All the developments in the applications of electronics started with these. The fundamental components spawned into a range of signal and power devices. An engineer has to understand these devices which the building blocks of the circuits and systems.

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

- 1. Describe the purpose and methods of measurements and the errors associated with measurement.
- 2. Identify the biomedical applications of passive and active transducers using their principles of operation.
- 3. Explain the biomedical applications of photoelectric and piezoelectric transducers using their principles of operation.
- 4. Interpret the principles of signal conditioning and signal analyzers.
- Illustrate the performance and characteristics of display and recording devices. 5.

PN JUNCTION DIODE UNIT 1

Construction, Theory and operation of PN junction diode - VI Characteristics - current equation -Diode resistances and capacitances – Ratings – Applications - Zener diode and its characteristics – voltage regulation using zener diodes.

UNIT 2 BJT TRANSISTOR

Principle of operation of PNP and NPN transistors - study of CE, CB and CC configurations and comparison of their characteristics.

UNIT 3 FET AND MOSFET

Construction, Operation, Characteristics and Application of JFET - JFET Parameters -JFET as VVR. Construction, Operation, Characteristics and Application of MOSFETs - EMOSFET and DMOSFET.

SPECIAL PURPOSE DIODES UNIT 4

Construction, Operation, Characteristics and Application of Tunnel diode, Varactor diode, LED, Laser diode, Photodiode, Gunn diode, Schottky Diode.

UNIT 5 POWER DEVICES AND DIODE APPLICATIONS

Construction, Operation, Characteristics and Application of SCR, DIAC, TRIAC-IGBT. Operation and Analysis of Rectifiers: Half-Wave and Full-Wave (both centre-tapped and bridge types) Rectifiers with capacitor filters

TEXT BOOKS:

- Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10th Edition, 1. Pearson Education / PHI, 2009.
- 2. Salivahanan S. & Sureshkumar N. "Electronic Devices and Circuits", McGraw Hill Education, 3rd Edition, Fifth Reprint, 2014.

REFERENCES:

- 1. V.K.Mehta, Principles of Electronics, S.Chand& Co., 2011.
- J. Millman, C CHalkias&SatyabrataJit, "Electronic Devices & Circuits", Tata McGraw Hill, 2. 4thEdition, 2015.
- 3. David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press, 2008.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/117101106/1, Analog Circuits, Prof. A N Chandorkar, IIT Bombay.
- 2. http://nptel.ac.in/courses/117103063/2, "Basic Electronics", Dr.Chitralekha Mahanta, IIT. Guwahati.

Lecture : 45, Tutorial : 0, Total : 45

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ENVIRONMENTAL SCIENCE AND ENGINEERING

Preamble:

21MCT02

The study of biodiversity reflects the extent of the interest of a nation in its natural resources and heritage, which is considered as a crucial portion of the national wealth. Since India is one of the twelve mega- diversity center of the earth, much emphasis should be put on understanding, preserving and utilizing the biodiversity of our biotic resources. Environmental protection is an important issue for society today as scientific research provides evidence of increasing global warming, ozone depletion and higher levels of pollution. Engineers should learn how to design, develop and evaluate structures, equipment and systems to provide practical solutions to problems caused by pollution, exploitation of natural resources and population explosion.

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

- 1. Compare and contrast structure and function of forest and marine ecosystem to conserve biodiversity.
- 2. Analyze the sources, effects, control measures of air and water, solid waste management to maintain green environment.
- 3. Describe overexploitation of forest, overutilization of water and environmental impacts related to food resources to preserve environment.
- 4. Explain human health, environment and disaster management through information technology.
- 5. Discuss air and water act to solve environmental issues of climatic change.

UNIT 1 ECOSYSTEM AND BIODIVERSITY MANAGEMENT

Importance of environmental studies-Ecosystem-Definition, Characteristics, structure and functions of Forest and Ocean ecosystem. Biodiversity-Definition, Significance, Values of biodiversity, Threats to biodiversity-Habitat loss and poaching, Biodiversity conservation-In-situ (Biosphere and National Park), Ex- situ (Gene bank and Seed bank)

UNIT 2 ENVIRONMENTAL POLLUTION

Pollution- Definition causes and effects of Air and Water. Control strategies-Air pollution- (Catalytic converter,Cyclone separator). Water pollution-waste water treatment (Primary, Secondary and Tertiary Treatment). Solid waste-Source and generation of solid waste, Methods of disposal- Sanitary land fill, Incineration and composting.

UNIT 3 NATURAL RESOURCES

Forest Resources: Functions of forest, deforestation-causes, consequences and steps to prevent deforestation. Water Resources: over-exploitation of surface and ground water, Benefits and problems of dams on forests and tribal people. Food Resources: Environmental impacts related to food resources –Effects of modern agriculture (fertilizer and pesticide problems), water logging and salinity.

UNIT 4 ROLE OF IT AND DISASTER MANAGEMENT

Role of IT in environment-Remote Sensing and GIS application, Global positioning system, Environmental data base. Role of IT in human health – EHR, Medical Transcription, Endoscopy, Automated dispensing machine (ADM), Teleconference, Picture achieving and Communication System (PACS) method. Disaster management-Cause, effects and mitigation of Flood, Cyclone, Earthquake, Tsunami

UNIT 5 SOCIAL ISSUES AND ENVIRONMENTAL LEGISLATION

Social Issues: Climate change- Global warming, Ozone layer depletion, Water conservation-Rain water harvesting (Roof top method). Legislation- Function of State and Central pollution control Board (Air and Water).

Lecture: 30, Tutorial : 0, Total : 30

TEXT BOOKS:

- 1. Dr.ArunLuiz T, "Environmental Science and Engineering", 1st edition (2017), VK publications.
- 2. P. Yugananth&Dr. R. Kumaravelan," Environmental Science and Engineering", 2ndedition, reprint (2017),Scitech Publication (India) Pvt. Ltd., Chennai.

REFERENCES:

- 1. Benny Joseph, "Environmental Science and Engineering", 3rdreprint (2015), McGraw Hill Education (India) PvtLtd. New Delhi.
- 2. Gilbert M.Masters, "Introduction to "Environmental Engineering and Science", 2nd edition (2004), Prentice Hall of IndiaPvt. Ltd.

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e-RESOURCES:

- 1. https://nptel.ac.in/courses/105104099/4"Types and forms of Air Pollutants"Prof. Mukesh Sharma, Department of Civil Engineering, IIT Kanpur.
- 2. https://nptel.ac.in/courses/105104213/8-"Introduction to natural hazards(Flood and Tsunami) Prof.Javed Malik, Department of Civil Engineering, IIT Kanpur.

21ECL21 CIRCUITS AND DEVICES LABORATORY

Preamble:

The goals are to supplement the theory courses Semiconductor Devices and Basic Electrical Engineering to assist the students in obtaining a better understanding of the operation of electronic circuits and devices and to provide experience in analyzing network theorems.

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

- 1. Experiment and test the given electric circuit using Kirchhoff's laws and obtain the mesh current & node voltage and obtain the load current for the given circuit using Superposition, Thevenin's, and Norton's and Reciprocity theorems.
- 2. Construct and test RLC series and parallel circuits to compute the resonant frequency and bandwidth by plotting the frequency response.
- 3. Experiment and determine the VI characteristics of given PN junction diode, Zener diode, Photodiode and Silicon Controlled Rectifier.
- 4. Experiment and determine the Input & output characteristics of BJT and drain & transfer characteristics of JFET.
- 5. Experiment and test half wave and full wave rectifier circuit using PN Junction diode and obtain the ripple factor, rectifier efficiency and experiment and test voltage regulation characteristics using Zener diode voltage regulator circuit.

LIST OF EXPERIMENTS

- 1. Verification of KVL and KCL.
- 2. Verification of Thevenin's and Norton's Theorems.
- 3. Verification of superposition Theorem.
- 4. Verification of Maximum power transfer and reciprocity theorems.
- 5. Frequency response of RLC series and parallel resonance circuits.
- 6. Characteristics of PN and Zener diode.
- 7. Characteristics of CE, CB configurations.
- 8. Characteristics of JFET.
- 9. Half wave and Full wave rectifier with capacitor filter.
- 10. Voltage regulation using zener diode.
- 11. Study of characteristics of photo diodes.
- 12. Study of characteristics of SCR.

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45

21BML31 PATHOLOGY AND MICROBIOLOGY LABORATORY L T P C

L T P C 0 0 2 1

Preamble:

Pathology and microbiology tests are an integral part of many public health interventions, guiding delivery of appropriate therapy, and often reducing drug wastage and inappropriate treatment. This course is to provide practice to learn fundamental approaches for experimentally investigating normal homeostasis, pathological stimuli, pathological conditions and physiological stress.

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

- 1. Experiment and Perform Hematology, Biochemistry and Microbiology tests for disease diagnosis.
- 2. Experiment and Identify the structure of bacteria using microscope.
- 3. Experiment and Identify the morphological changes in cancer, leukemia and lymphoma cell using microscope.
- 4. Experiment and Count the bacteria in the given sample.
- 5. Analyze the biochemical characteristics of microorganisms by using virtual lab.

LIST OF EXPERIMENTS

- 1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
- 2. ABO and Rh blood grouping
- 3. Determination of Bleeding Time and Clotting Time
- 4. Simple staining.
- 5. Gram staining.
- 6. AFB staining
- 7. Histopathological slides of tumors(benign and malignant), leukemia and lymphoma and Manual paraffin tissue processing and section cutting (demonstration)
- 8. Enumeration of microorganisms-Direct Count Using a Counting Chamber
- 9. Testing sensitivity to antimicrobial substances
- 10. The virtual study of microorganisms: Aseptic Technique and the Transfer of Microorganisms || Streak Plate Method || Motility Test || Catalase and Coagulase Test || Selective and Differential Media for Identifying Microorganisms || Bacterial Growth Curve || Carbohydrate Fermentation Test || Antibiotic Susceptibility Testing || Methylene Blue Reductase Test.

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45

21M	CL03 ESSENTIAL ENGLISH FOR PROFESSIONALS (Common to All Branches in Third Semester)	L 0	Т 0	Р 2	C 0
Prea	mble:				
Com cours	municative English is a life skill necessary for all students of Engineering and Tech se Essential English for Professionals aims at enabling the learners to communicate	nolo effe	ogy. ' ctive	The ely	
and a	appropriately in professional contexts by exposing them to LSRW tasks.				
Cour	se Outcomes: Upon completion of the course, students will be able to				
1.	Analyze the given listening material and answer the questions correctly employing techniques.	; list	enin	g	
2.	Analyze the given reading material and answer the questions correctly employing techniques.	read	ing		
3.	Write within the stipulated time syntactically and semantically correct sentences to the form of paragraphs and letters.) pre	sent	idea	s in
4.	Give well-structured effective time sensitive presentations extemporaneously or af	ter c	aref	ul	
	preparation.				
5.	Identify within the stipulated time syntactically and semantically correct sentences	for	a va	riety	of
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Lista	ning to Casual Conversation and TED Talks				0
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and I	Paragraph Writing.	sung	gCei	fillica	ates
UNIT	F4 PRESENTATION			,	7
Wate	hing Presentations - Presentation Techniques - JAM and Three Minute Presentation				
UNIT	5 VERBAL ABILITY				3
Verb	al Analogy - Cloze Test- Idioms and Phrases- Sentence Completion – Concord – Concert –	mmo o <mark>rial</mark>	on Ei :0, 1	rors Fotal	: 30
TEX	Г BOOKS:				
1. 2.	Rizvi, Ashraf. M, "Effective Technical Communication", 2 st Edition, Tata McGraw-Hill, I Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills fo	New r En	Delh ginee	i,201 ers", 1	8.

Edition, Oxford University Press, New Delhi. 2008.

e-RESOURCES:

- 1. https://agendaweb.org/listening/audio-books-mp3.html
- 2.
- https://www.ndtv.com/world-news https://www.naukri.com/blog/self-introduction-for-interview/ 3.
- http://learnenglishteens.britishcouncil.org/skills/reading https://www.bbc.com/bitesize/guides/zphc9j6/revision/1 4.
- 5.

21MAT41

PROBABILITY AND RANDOM PROCESSES (Common to B.E. BM, EC, MD programmes in Fourth Semester)

Preamble:

Probability theory is used extensively in the design of modern communication systems in order to understand the behavior of noise in the system. It is concerned with the study of one-dimensional random variables. The concept of random process deals with time varying function and plays a vital role in modeling physical phenomenon. The language of signal coding is primarily that of random processes and linear systems. The response of an LTI system to random signals plays an important role in signal analysis.

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

- Compute moments and moment generating functions of one dimensional random variables and solve the 1. problems involving discrete and continuous distributions.
- Measure the degree of relationship between the two dimensional random variables using correlation and 2. regression.
- Classify the first and second order stationary processes and solve the problems involving Markov and 3. Poisson processes.
- Solve problems involving correlation and spectral densities of random processes. 4.
- Analyze the response of random inputs to linear time invariant systems 5.

UNIT 1 **ONE DIMENSIONAL RANDOM VARIABLES**

Discrete and continuous random variables - Moments - Moment generating functions - Distributions: Discrete distributions - Binomial, Poisson - Continuous distributions - Uniform, Exponential and Normal distributions.

TWO DIMENSIONAL RANDOM VARIABLES UNIT 2

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression. UNIT 3 **RANDOM PROCESSES** 9+3

Classification - Stationary process - First order, Second order Stationary Process, SSS Process, WSS Process -Markov Process - Poisson Process.

UNIT 4 CORRELATION AND SPECTRAL DENSITIES

Auto correlation functions - Cross correlation functions - Properties - Power spectral density - Cross spectral density-Properties (Excluding Proof).

UNIT 5 LINEAR SYSTEMS WITH RANDOM INPUTS

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

TEXT BOOKS:

- 1. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition 2014.
- Hwei Hsu, " Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New 2. Delhi, 3rd Edition, 2014.

REFERENCES:

- 1. Veerarajan T., "Probability Statistics and Random Processes with Queueing theory and Queueing Networks", 4th Edition, Tata McGraw Hill Edition, New Delhi, 2015.
- Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to SignalProcessing", 2. 3rd Edition, Pearson Education, Asia, 2002.
- Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGrawHill, 4th 3. Edition, New Delhi, 2002.

e-RESOURCES:

- http://nptel.ac.in/courses/117105085/7, "Probability and Random Variables", Prof. M. Chakraborty, 1. Department of Electronics and Electrical Communication Engineering, Indian Institute of Technology, Kharagpur.
- http://nptel.ac.in/courses/111102014/, "Stochastic Processes", Prof. Dr. S. Dharmaraja, Department of 2. Mathematics, Indian Institute of Technology, Delhi.

Lecture: 45, Tutorial : 15, Total : 60

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21ITC41 DATA STRUCTURES USING OBJECT ORIENTED PROGRAMMING L T P C CONCEPTS 3 0 2 4

Preamble:

This course provides the data structures and object oriented programming concepts for the students to develop software in C++ Programming Language. It also demonstrates the C++ techniques and different data structures with associated algorithms by implementing the solutions to real world problems.

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

- 1. Design a C++ program using object oriented programming concepts for the given problem statement.
- 2. Develop linked list Abstract Data Type for a given set of elements using C++.
- 3. Create Stack and Queue Abstract Data Type for the given problem statement using an array.
- 4. Construct tree and graph Abstract Data Type for the given list of data by ensuring tree properties and analyze the tree and graph traversal for the constructed tree and graph Abstract Data Type.
- 5. Evaluate the searching and sorting algorithms for a given integer elements using linear search, binary search, bubble sort, insertion sort, and selection sort algorithms.

UNIT 1 INTRODUCTION TO C++

Introduction to C++ programming – Function in C++ - Classes and objects- Defining member functions – Constructors- Destructors- Inheritance.

UNIT 2 ARRAY AND LINKED LIST ADT

ADT"s and C++ classes –Array ADT- Implementation of Array ADT – Linked list ADT – Definition – Singly Linked List- Doubly Linked List – Applications of Linked List.

UNIT 3 STACK AND QUEUE ADT

Stack ADT – Array Implementation- Application of Stacks: Infix to postfix conversion- Evaluation of Postfix Expression – Queue ADT – Array Implementation.

UNIT 4 TREES AND GRAPHS

Trees: Binary Tree – Binary Tree Traversal – Binary Search Tree, Graphs: Definitions- Graph Representation- Graph Traversal.

UNIT 5 SORTING AND SEARCHING

Sorting Algorithms: Bubble Sort, Selection Sort, Insertion sort –Searching Algorithms: Linear Search, Binary Search. Case study: Medical Diagnostic System.

EXPERIMENTS:

- 1. Design a C++ program to implement an array ADT for a given set of elements.
- 2. Develop a C++ program to implement insert, search and display operations in a singly linked list for a given list of databy ensuring the ordering of data elements. (3 hours)
- 3. Design a C++ program to perform stack and queue operations by applying array concept for a given list of data.
- (3 hours) 4. Construct a binary search tree thereby performing insertion, deletion, and search operations for given list of data.
- 5. Construct a "C" program to perform searching and sorting of data by applying suitable searching and sorting technique for a given problem. (3 hours)

Lecture: 45, Tutorial : 15, Total : 60

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(3 hours)

(3 hours)

1. E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill Company Ltd., 7th Edition, 2017.

2. YashavantKanetkar, "Data Structures through C++", 2nd Edition, BPB Publications, 2012.

REFERENCES:

TEXT BOOKS:

- 1. SartajSahni, "Data Structures, Algorithms and Application in C++, 2nd Edition, Universities Press (India) Private Limited, 2011.
- 2. BhushanTrivedi, "Programming with ANSI C++, A Step-By-Step approach", Oxford University Press, 2010.
- 3. BjarneStroustrup, "The C++ Programming Language", 4th Edition, Addison Wesley, 2013.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/106105151, "Programming in C++", Prof.PrathaPratim Das, Department of computer science, IIT Kharagpur.
- 2. https://nptel.ac.in/courses/106102064/, "Introduction to Data Structures and Algorithms", Prof Naveen Garg, IIT Delhi.

21BMT41

ELECTRONIC CIRCUITS

Preamble:

The course introduces the biasing of BJTs, FETs and MOSFETs in constructing amplifiers. It also details the structure and properties of feedback for analysing amplifiers and oscillators. Additionally, the course exposes the analysis and design of waveshaping and multivibrator circuits.

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

- 1. Design transistor amplifiercircuits with Fixed, Collector to Base, Voltage divider biasing techniques.
- Evaluate Class A, B, AB, C amplifiers for a given load with respect to its efficiency. 2.
- Analyze feedback amplifiers and identify suitable amplifier for a given application using gain, input-3. output resistance and bandwidth.
- 4. Analyze the performance and characteristics of RC and LC oscillator circuits.
- Design wave shaping and multivibrator circuits using active and passive components for a given 5. application.

UNIT 1 BIASING OF BJT AND FET

Bias Stability – Need for biasing – quiescent point – DC load line and AC load line – Thermal runaway. Stability factors, Different types of biasing circuits - Fixed bias - Collector to base bias - Voltage divider bias. Biasing the FET, Biasing the MOSFET.

UNIT 2 AMPLIFIERS

Differential amplifier - transfer characteristics - Class A amplifiers: Direct coupled, transformer coupled efficiency – Class B amplifier: push-pull amplifier – complementary symmetry amplifier – efficiency – Cross over distortion. Class AB amplifier, Class C amplifier.

UNIT 3 FEEDBACK AMPLIFIERS

General Feedback Structure, Determining the Loop Gain, Properties of negative feedback, Basic Feedback Topologies. Method of identifying feedback topology and feedback factor - Voltage Series Feedback -Current Series Feedback - Current Shunt Feedback - Voltage Shunt Feedback, Stability of feedback amplifier.

UNIT 4 OSCILLATORS

Classification, Barkhausen Criterion, General form of an LC Oscillator, Hartley, Colpitts. RC Oscillators -Phase Shift – Wien bridge. Frequency range of RC and LC Oscillators, Crystal Oscillators – Quartz Crystal Construction, Miller and Pierce Crystal oscillators, frequency stability of oscillator.

UNIT 5 WAVE SHAPING AND MULTIVIBRATOR CIRCUITS

RC Integrator and Differentiator circuits - Storage, delay and calculation of transistor switching times -Speed- up capacitor, Diode clippers, Clampers. Collector coupled Astable multivibrator and Monostable multivibrator, Bistable multivibrator, Schmitt trigger circuit – UJT sawtooth waveform generator.

TEXT BOOKS:

- Salivahanan S. & Sureshkumar N. "Electronic Devices and Circuits", McGraw Hill Eduation, 3rdEdition, 1. Fifth Reprint, 2014.
- Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", 6th Edition, Oxford University Press, 2. 2011.

REFERENCES:

- Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson 1. Education / PHI, 2009.
- J. Millman, C CHalkias&SatyabrataJit, "Electronic Devices & Circuits", Tata McGraw Hill, 4thEdition, 2. 2015.

e-RESOURCES:

- http://nptel.ac.in/courses/117103063/2, "Basic Electronics", Dr.ChitralekhaMahanta, IIT, Guwahati. 1.
- httyp://nptel.ac.in/courses/117101106/1, "Analog Circuits" Prof.A.N.Chandorkar, IIT Bombay. 2.

Lecture: 45, Tutorial : 15, Total : 60

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21BMT42

Preamble:

This course introduces the basic building blocks of the integrated circuits along with fundamental concepts in digital logic systems and linear integrated circuits. It also provides knowledge in code conversion, Boolean simplification using karnaugh map and designing of simple IC based circuits.

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

- 1. Simplify the given boolean expression using karnaugh map and implement using universal logic gates.
- 2. Design a modulo N counter using state diagrams.
- 3. Design a linear and non-linear circuits using op amp.
- 4. Design a first order and second order active filters and signal generators using op-amp.
- 5. Design application circuits using 555 Timer, 565 PLL, 0808DAC, 0809ADC.

UNIT 1 NUMBER SYSTEMS AND LOGIC GATES

Decimal, Binary, Octal and Hexadecimal Numbers-Conversion between these number systems – r's Complements and (r-1)'s complements-subtraction using complements-Encoding numbers and characters using Binary digits – Binary coded Decimal- Gray code- Binary to Gray code conversion –ASCII Code. The Karnaugh Map – Half adder and Full adder- Multiplexers and Demultiplexers – Decoders and Encoders. Coding of Combination Circuits in Verilog.

UNIT 2 REGISTERS AND COUNTERS

Flip Flops-RS ,D,T,JK Flip Flops- Characteristics equations, exciting tables,JK Master Slave Flip Flop,Universal shift register, Design of modulo – N counters, counter design using state diagram, sequential circuit design with verilog.

UNIT 3 OPERATIONAL AMPLIFIERS

The characteristics of Ideal Operation, Slew rate, Offset voltage, Bias current, CMRR, Bandwidth, Equivalent circuit of an op-amp, Virtual ground concept, Linear application of op-amp - inverting and non inverting amplifiers, summing, subtracting, averaging amplifiers, Voltage to current converter, current to voltage converter, Differential amplifiers, Differentiator and Integrator. Non Linear applications- Comparator, Schmitt triggers, Precision Diode Half wave and Full wave rectifiers, Peak detector.

UNIT 4 ACTIVE FILTERS AND SIGNAL GENERATORS

Active Filters (First and Second order)- Low pass, High pass, Band pass, Band reject filters (Notch Filters). Oscillators – RC phase shift and Wein-Bridge. Waveform generators – Square, Triangular and Sawtooth.

UNIT 5 TIMER, PLL, A/D AND D/A CONVERTERS

555 Timer -internal diagram and its applications- monostablemultivibrator, astablemultivibrator, Phase Locked Loop(565)- block diagram approach and its applications- Frequency multiplication, Frequency translation, Voltage to frequency and Frequency to voltage converters, Binary weighted DAC and R-2R DAC - 0808DAC, Successive approximation ADC - 0809ADC

Lecture: 45, Tutorial : 15, Total : 60

TEXT BOOKS:

- 1. M. Morris Mano and Michael D. Ciletti, "Digital design" 5th EditionPearsonEducation, New Delhi, 2013.
- 2. Ramakant A. Gayakwad , "Op-AMP and Linear Ics", 4th Edition, Prince Hall, 2016.

REFERENCES:

- 1. S.Salivahanan& S.Arivazhagan,"Digital Circuits and Design", 4th edition, Vikas publishing house Pvt. Ltd, 2012.
- 2. Charles H. Roth Jr, "Fundamentals of Logic Design", 7thEdition, Jaico Publishing House, Mumbai, 2014.
- 3. Robert B.Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

e-RESOURCES:

- 1. http://nptel..iitm.ac.in/courses/117106086, "Digital Circuits and Systems-video", Prof.S.Srinivasan, IITM.
- 2. http://www.satishkashyap.com/2012/02/digital-electronic-circuits-by-shouri.html,"Digital Electronics", Dr.ShouriChatterjee, IIT- Delhi.
- 3. http://nptel.ac.in/courses/117103063/26, "Ideal op-amp and its applications" Dr. ChitralekhaMahanta Department of Electrical and Communication Engineering Indian Institute of Technology, Guwahati.

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BIOMATERIALS AND ARTIFICIAL ORGANS

Preamble:

21BMT43

This course is to develop the understanding of classification, biocompatibility and properties of biomaterials. Biomaterials are synthesized biologically and chemically by utilizing metallic components, polymers, ceramics or composite materials. It is used in orthopaedic application, dental applications and artificial organs.

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

- Categorize the structure of biomaterials using its bio-compatibility, mechanical properties and to study 1. wound- healing process.
- Analyze the nature and structural characteristics of metallic and ceramic implant material using its 2. property relationship.
- 3. Analyze the nature and structural characteristics of polymers and composite biomaterials using its properties for biomedical applications.
- Evaluate the metallic, ceramic, polymer and composite biomaterials that could be used to replace 4 tissues in the body during tissue replacement implants.
- Illustrate the design procedure of artificial organs using biomaterials. 5.

UNIT 1 STRUCTURE OF BIO-MATERIALS AND BIO-COMPATIBILITY

Definition and classification of bio-materials, mechanical properties of biomaterials, structure property relationship of biological and biomaterials visco elasticity, wound-healing process, body response to implants, blood compatibility, carcinogenicity.

UNIT 2 IMPLANT MATERIALS I

Metallic implant materials: stainless steels, cobased alloys, Ti-based alloys, Dental metals, Deterioration of metallic implant materials-ceramic implant materials: Structure-Property Relationship of Ceramics, aluminum oxides, zirconia, hydroxyapatite, glass ceramics, carbons.

UNIT 3 IMPLANT MATERIALS II

Polymerization, polyamides, Acryrilic polymers, rubbers, high strength thermoplastics, Deterioration of polymers - Bio polymers: Collagen and Elastin. Composites - structure, mechanics, biocompatibility, applications. Materials for ophthalmology: contact lens, intraocular lens. 9

UNIT 4 TISSUE REPLACEMENT IMPLANTS

Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, internal fracture fixation devices, joint replacements.

UNIT 5 ARTIFICIAL ORGANS

Blood substitutes, Artificial skin, Artificial Heart, Prosthetic Cardiac Valves, Artificial lung (oxygenator), Artificial Kidney (Dialyser membrane), Artificial Pancreas, Dental Implants.

TEXT BOOKS:

- Park, J.B and Lakes, R.S., "Biomaterials An Introduction", Springer Publications, 3rd edition, USA, 1. 2007.
- Sujata V. Bhatt, "Biomaterials", Narosa Publishing House, 2nd Edition, 2005. 2.

REFERENCES:

- Joseph D.Bronzino "Tissue Engineering and Artificial Organs", 3rdEdition, Taylor and Francis, 2006. 1.
- John Enderle, Joseph D. Bronzino, Susan M. Blanchard, Elsevier, "Introduction to Biomedical 2. Engineering", 2nd Edition, 2005.
- BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, "An introduction to Materials in Medicine" 3. Academic Press, 2ndEdition, 1996.

e-RESOURCES:

http://nptel.ac.in/courses/113104009/, Introduction to Biomaterials, Prof. BikramjitBasu, Prof. 1. KanteshBalani, Department of Materials and Metallurgical Engineering, Indian Institute of Technology, Kanpur.

Lecture: 45, Tutorial : 0, Total : 45

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- 2. http://nptel.ac.in/courses/113108071/, Biomaterials for bone tissue engineering applications, Prof.BikramjitBasu, Materials research centre, Indian Institute of Science, Bangalore.
- 3. <u>https://ocw.mit.edu/courses/biological-engineering/20-441j-biomaterials-tissue-interactions-fall-2009/</u> index.htm, Biomaterials tissue interactions,Prof. IoannisYannas, Prof. Myron Spector, Department of biological engineering, MIT.

VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

21BMT44

Preamble:

The course covers the process of hospital planning in general with outpatient service and nursing services. It also covers topics on planning, organizing, directing and controlling and the descriptions on individual clinical and other departments. The course also covers hospital safety and security.

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

- 1. Describe the basic planning and organization of hospitals using guiding principles.
- 2. Explain the roles and responsibilities in Hospital Administration, Human Resource management and finance management with organizational hierarchy.
- 3. Identify and explain the role of medical and support services used for proper functioning of the hospitals.
- 4. Classify administrative services functional organization and engineering services of a hospital.
- 5. Identify and explain the key elements of security and safety management in Hospitals.

UNIT 1 HOSPITAL PLANNING AND DESIGN

The role of hospitals in Healthcare – Hospital Planning and Design – Guiding principles in planning - Regionalization of hospital services – Hospital Planning Team – Zonal Distribution and inter-relationship of Departments – Gross space requirements – Climatic consideration in design – Preparation of Functional brief – Equipping a Hospital – Construction and commissioning.

UNIT 2 MANAGEMENT AND FINANCIAL MANAGEMENT

Principles of Management – Roles and functions of Hospital Administration – Skills of effective Managers – Characteristics of Effective Managers - Planning – Criteria for Effective Planning - Decision Making – Strategic Planning - The organizational chart – Financial planning – Cause of rise in hospital expenditure - revenue centers and cost centers - Hospital budgets.

UNIT 3 MEDICAL AND SUPPORTIVE SERVICES

Outpatient services – Definition, Planning of outpatient services – Planning considerations, ancillary services – Policies and Procedures - Clinical Laboratory services – Functional divisions and Functional planning – Policies and Procedures – Quality controls – Operational theatre suite – Facilities in the OT – Zoning – Functional interrelationships of rooms - Policies and Procedures – Intensive care units – Types of ICU – Planning and Organization - Pharmacy – Central Sterile Supply Department (CSSD) – Functions of CSSD – Policies and procedures - Autoclaving.

UNIT 4 HOSPITAL FACILITY AND FUNCTIONAL SERVICES

Medical Records – Materials management – Process- Purchasing – Inventory – Issue and Distribution – Hospital Linen and Laundry Services – Linen classification and requirement of equipment - Engineering departments – Electrical system- Air conditioning system- Water supply and Aanitary system – Centralized medical gas system.

UNIT 5 HOSPITAL SAFETY AND SECURITY

Safety in hospital – Security and loss prevention programme – Fire safety - Alarm system- Disaster management.

TEXT BOOKS:

- 1. B.M. Sakharkar, "Principles of hospital administration and planning", Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.
- 2. G.D.Kunders, "Hospitals Facilities Planning and Management TMH, New Delhi Fifth Reprint 2007.

REFERENCES:

- 1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI Fourth Edition, 2006
- 2. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering, Academic Press, New York, 1977.

Lecture: 45, Tutorial : 0, Total : 45

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e-RESOURCES:

- 1. https://www.youtube.com/watch?v=ZZS8-ySBNFM, "Organisation and Management of Hospital", Prof. S.B.Aroara, Professor, School of Health Sciences, Indira Gandhi National Open University (IGNOU), MaidanGarhi, New Delhi
- 2. http://www.nptelvideos.in/2012/11/human-resource-management-i.html, "Lecture Series on Human Resource Management-I", Prof. KalyanChakravarti, Vinod Gupta School of Management, IIT Kharagpur.

21BML41 ELECTRONIC CIRCUITS LABORATORY

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Preamble:

The course introduces the fundamental principles of amplifier circuits and to familiarize feedback amplifiers and oscillators. It also gives insight into SPICE simulation of electronic circuits.

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

- 1. Measure CMRR of a differential amplifier, experiment and determine the frequency response of class A and class B power amplifiers.
- 2. Experiment and determine the frequency response of feedback amplifiers.
- 3. Design and test RC and LC oscillators.
- 4. Construct and test wave-shaping circuits.
- 5. Simulate Bistable multivibrator and Schmitt trigger using SPICE Tool.

LIST OF EXPERIMENTS

- 1. Differential Amplifier CMRR measurement.
- 2. Class A and Class B power amplifiers.
- 3. Frequency response of voltage shunt feedback amplifier.
- 4. Frequency response of current series feedback amplifier.
- 5. RC Phase shift oscillator and Wien bridge oscillator.
- 6. Hartley oscillator and Colpitts oscillator.
- 7. RC Integrator and Differentiator circuits.
- 8. Clippers and Clampers.
- 9. Astable and Monostable Multivibrators.
- 10. SPICE Simulation of Bistable Multivibrator and Schmitt trigger circuit.

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45

21BML42

ANALOG AND DIGITAL INTEGRATED CIRCUITS L T P C LABORATORY 0 0 2 1

Preamble:

This course is to provide practice in designing of combinational and sequential logic circuits. It also gives design experience in analog circuits in implementing amplifiers, active filters, waveform generators, comparator, multivibrators.

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

- 1. Design and Test adder, decoder, encoder, multiplexer, demultiplexer using logic gates.
- 2. Design and Test Sequential circuits using flip flops.
- 3. Design and Test inverting, non inverting amplifier, integrator, differentiator, active filters, comparator and peak detector circuits using IC741.
- 4. Design and test multivibrator circuits using IC 555.
- 5. Experiment and Test Analog to Digital & Digital to Analog Converter ICs.

LIST OF EXPERIMENTS

- 1. Half adder and Full adder.
- 2. Encoder and Decoder, Multiplexer and Demultiplexer using logic gates.
- 3. Universal shift register using flip flops.
- 4. Design of Mod-N counter.
- 5. Inverting, Non-inverting amplifier, Integrator and Differentiator using IC741.
- 6. Second order low pass and high pass active filters using IC741.
- 7. Comparator, Peak detector using IC 741.
- 8. Wein Bridge Oscillator.
- 9. Multivibrator using IC 555 Timer.
- 10. Analog to Digital Converter using 0809ADC and Digital to Analog Converter using 0808DAC.

Lecture : 0, Tutorial : 0, Practical : 45, Total : 45

21MCL04	PROFESSIONAL COMMUNICATION	\mathbf{L}	Т	Р	С
	(Common to All Branches in Fourth Semester)	0	0	2	0

Preamble:

Communicative English is a life skill necessary for all students of Engineering and Technology. The course Professional Communication aims at enabling the learners to communicate effectively and appropriately in professional contexts by exposing them to LSRW tasks.

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

- 1. Analyze the given listening material and answer the questions correctly, employing listening techniques.
- 2. Take part effectively in group discussions, conforming to professional norms.
- 3. Analyze the given reading material and answer the questions correctly, employing reading techniques.
- 4. Write within the stipulated time, syntactically and semantically correct sentences to present ideas in the form of an essay.
- 5. Identify within the stipulated time syntactically and semantically correct sentences for a variety of language exercises.

UNIT 1 LISTENING

	v
Listening to News Bulletins and Documentaries.	
UNIT 2 GROUP DISCUSSION	8
Watching Group Discussion videos – Do's and Don'ts of GD – Mock GD.	
UNIT 3 READING	6
Letters to Editor Column - Reading News Articles - Biographies of Famous Personalities.	
UNIT 4 WRITING	6
IELTS Essay Writing.	
UNIT 5 VERBAL ABILITY	4
Verbal analogy - Cloze Test- Idioms and Phrases- Sentence Completion -Error Spotting.	

Lecture: 30, Tutorial : 0, Total : 30

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TEXT BOOKS:

- 1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: English Skills for Engineers", 1st Edition, Oxford University Press, New Delhi. 2008.
- 2. Rizvi, Ashraf. M, "Effective Technical Communication", 2st Edition, Tata McGraw-Hill, New Delhi,2021.

e-RESOURCES:

- 1. http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
- 2. https://www.bbc.com/bitesize/guides/zphc9j6/revision/1
- 3. https://www.fresherslive.com/online-test/verbal-ability-test/questions-and-answers

VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

21BMT51

Preamble:

This course provides the fundamental concepts of microprocessor and microcontroller architectures. It describes the interfacing of memory and peripheral devices with microprocessor and microcontroller. The students showcase their skills in embedded applications development with microprocessor and microcontroller.

MICROPROCESSOR AND MICROCONTROLLER

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

- Illustrate the Architecture and Memory segmentation of 8086 Microprocessor. 1
- 2 Identify the pin configurations of interfacing IC's for the peripherals devices.
- 3 Describe the Architecture and pipeline organization of ARM processor.
- Develop Assembly programs for the given problems using 8051 Instruction set. 4
- 5 Design circuits to implement simple embedded applications using microcontroller.

INTRODUCTION TO MICROPROCESSOR UNIT 1

Introduction to microprocessor - Register Organization - Architecture of 8086 - Memory segmentation - Memory Banking - Pin Diagram of 8086 - Instruction set.

UNIT 2 **PERIPHERALS AND THEIR INTERFACING WITH 8086**

Programmable peripheral Interface 8255 – Interfacing of ADC 0809 and DAC 0808 using 8255 – The matrix keyboard and seven segment display interfacing using 8255 - Stepper motor Interface - Programmable interval timer 8254.

UNIT 3 **ARM PROCESSOR ARCHITECTURE**

ARM Architecture-ARM programmer's model - ARM development tools. Pipelining -3-stage pipeline ARM organization, 5-stage pipeline ARM organization. ARM instruction execution, ARM Instruction Set. 9

8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING **UNIT 4**

8051 Architecture - 8051 Memory organization - Structure of internal ROM and RAM - 8051 registers - Addressing modes - 8051 instruction set - 8051 Timer section and programming - Serial port programming - 8051 I/O programming-Interrupts.

UNIT 5 **INTERFACING MICROCONTROLLERS**

Seven segment display interfaces - Keyboard interfacing -ADC Interfacing - DAC interfacing -DC Motor -Stepper motor interfacing.

Lecture:45, Tutorial:0, Total: 45

TEXT BOOKS:

- Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New 1. Delhi, 2012.
- 2. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 2014.
- Steve Furber, ARM system on chip architecture, second edition, Addison Wesley, 2000. 3.

REFERENCES:

- Yu-Cheng Liu, Glenn A. Gibson, "Microcomputer Systems: The 8086/8088 Family Architecture, Programming 1 and Design", Pearson, 2nd Edition, 2015.
- Kenneth J. Ayala, "8051 Microcontroller: Architecture, Programming and Applications", Cenage Learning, 3rd 2. Edition, 2007.
- Andrew N. Sloss, Donimic Symes, Chris Wright, ARM System Developer's Guide. 3.

e-RESOURCES:

- https://swayam.gov.in/nd1_noc20_ee42/, "Microprocessors And Microcontrollers", Prof. SantanuChattopadhyay, 1. Department of Computer Science and Engineering, IIT, Kharagpur.
- https://swayam.gov.in/nd1 noc20 ee11, "Microprocessors and Interfacing", Prof. Shaik Rafi Ahamed, 2. Department of Computer Science and Engineering, Indian Institute of Technology IIT Guwahati.

LTPC 3003

21BMT52

Lecture : 45, Tutorial : 0, Total : 45

Preamble

The course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance. The fundamental principles of equipment that are actually in use at the present day are introduced.

Course Outcomes: Upon completion of this course, students will be able to:

- Explain the bio electric phenomena and electrical models of electrode electrolyte interface. 1.
- Describe the diagnostic measurement method for identification of human biopotentials and their 2. necessary instrumentation.
- Discuss the recording and analysis of electrical and non electrical bio signals and its 3. characteristics.
- 4. Interpret the parameters and operation of non electrical diagnostic Modalities.
- 5. Explain the need and application of Intensive care equipments and patient safety.

UNIT 1 BIO POTENTIAL ELECTRODES

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, halfcell potential, polarization electrode - non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits.

UNIT 2 CARDIAC MEASUREMENTS

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor. Holter Monitor. Phonocardiography, Plethysmography. Foetal monitoring instruments- cardiotocograph - methods of monitoring foetal heart rate - Abdominal foetal electrocardiogram (AFECG) - Foetal phonocardiogram - FHR measurement from ultrasound doppler foetal signal - FHR measurement with direct FECG.

UNIT 3 NEUROLOGICAL MEASUREMENTS

EEG -10-20 electrode system- Montage- Multi-channel EEG recording system, sleep patterns, Evoked Potential- EMG - unipolar and bipolar mode- Apex cardiograph - Ballistocardiograph(BCG) - Electro occulograph (EOG), Electro retinography (ERG), Audiometer-Pure tone, Speech. Galvanic skin resistance (GSR) - Bio feedback instrumentation.

UNIT 4 MEASUREMENT OF NON ELECTRICAL PARAMETERS

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods auscultatory method, oscillometric method, direct methods: electronic manometer, Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, - measurement of continuous cardiac output derived from the aortic pressure waveform - Impedance technique ultrasound method - Electromagnetic and ultrasound blood flow measurement.

UNIT 5 EXTRA CORPOREAL DEVICES AND PATIENT SAFETY

Patient monitoring systems, ICU/CCU Equipments, Infusion pumps, bed side monitors, Central consoling controls-Telemetry- Portable and Land line- Macro shock - Micro shock hazards - Patient"s electrical environment - Isolated Power system - Conductive surfaces - Electrical safety codes and standards - Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

TEXT BOOKS:

- John G. Webster,"Medical Instrumentation Application and Design", John Wiley and sons, New 1. York, 2019.
- 2. Khandpur R.S,"Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.

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REFERENCES:

- 1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2016
- 2. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2016.
- 3. L.A Geddes and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2018.

e-Resources:

- 1. https://www.youtube.com/watch?v=XEv4K1gHUEo, "Recording a 12 lead ECG", Nick smith, Central Manchester University hospitals.
- 2. https://www.youtube.com/watch?v=2Cs4CJBaTN4, "Introduction to Biopotentials", Sarwar K, University of Texas.

VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

BIO CONTROL SYSTEMS

Preamble:

21BMT53

This course is to understand the concept behind feedback and continuum in various systems and subsystems. Analyze the system in time domain, frequency domain and understand the concept of stability. Apply the mathematical modeling principles in understanding the various fundamental biological systems.

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

- Identify and explain the open loop and closed loop control systems, using block diagram and signal flow graph 1. reduction techniques.
- Determine the time domain specifications for the closed loop transfer function with the given standard test input 2. signals.
- 3. Analyze the stability of the given system using Routh Hurwitz criteria, Root locus and Nyquist stability criteria techniques.
- Determine the frequency domain of the given system using bode and polar graphical plots. 4.
- 5. Design the models of physiological control system using the concepts of engineering control systems.

MODELING OF SYSTEMS UNIT 1

Terminology and basic structure of control system, examples of a control system, transfer functions, modeling of electrical systems, translational and rotational mechanical systems, and electromechanical systems, block diagram and signal flow graph representation of systems, conversion of block diagram to signal flow graph, reduction of block diagram and signal flow graph.

UNIT 2 TIME RESPONSE ANALYSIS

Test input signals, 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.

STABILITY ANALYSIS UNIT 3

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

UNIT 4 **FREQUENCY RESPONSE ANALYSIS**

Frequency response, definition of gain margin and phase margin, determination of gain margin and phase margin using Bode plot, Polar plot, determination of closed loop response using M and N circles, Nichol"s chart to compute response frequency and bandwidth.

UNIT 5 PHYSIOLOGICAL CONTROL SYSTEM

Example of physiological control system, difference between engineering and physiological controlsystems, generalized system properties, models with combination of system elements, linear models of physiological systems-Examples, introduction to simulation. Lecture: 45, Tutorial : 15, Total : 60

TEXT BOOKS:

- 1. M. Gopal "Control Systems Principles and Design", Tata McGraw Hill, 2002 (Units I, II, III & IV).
- Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2001 2.

(Unit V). **REFERENCES:**

- Benjamin C. Kuo, "Automatic Control Systems", Prentice Hall of India, 1995. 1.
- John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", secondedition, 2. Academic Press, 2005.
- Richard C. Dorf, Robert H. Bishop, "Modern control systems", Pearson, 2004. 3.

e-RESOURCES:

- https://nptel.ac.in/courses/107/106/107106081/, 'Control systems', PROF. C.S. SHANKAR RAM Department 1. of Design Engineering IIT Madras.
- https://www.edx.org/course/system-dynamics-health-sciences-witsx-hsd101x#!, "System Dynamics for Health 2. Sciences", David Rubin Adjunct Professor, Riomedical Engineering University of the Witwatersrand

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LTPC 3104

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21MCT05

APTITUDE AND LOGICAL REASONING (Common to All Branches in Fifth Semester)

Preamble:

Aptitude tests are used to determine an individual's ability/potential to succeed in a certain task, with no prior knowledge or training and are frequently used as part of a pre-employment assessment. Aptitude tests are a proven tool used to identify those who are best equipped to carry out any given role. A logical reasoning test is a form of testing that is widely used by corporate employers to help assess candidates during their recruitment process.

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

- 1. Solve the given equation using appropriate simplification methods.
- 2. Apply aptitude method of ratio and proportion to solve the given scenario.
- 3. Calculate time, speed, distance by applying suitable aptitude method for the given problem statement.
- 4. Calculate percentage and profit & loss for the given problem statement.

5	Compute simple interest, compound interest and predict relationship for the g	given
5.	problem/scenario.	
U	JNIT 1	6
Ν	Jumber System, Simple Equation, Sequence and Series	
U	JNIT 2	6
R	Ratio and Proportion, Problems on Ages, Partnership	
U	JNIT 3	6

Time and Distance, Problems on Trains, Boats and Streams UNIT 4 Percentage, Profit and Loss, Directions Sense UNIT 5

Simple Interest and Compound Interest, Blood Relations

Lecture: 30, Tutorial : 0, Total : 30

REFERENCES:

- 1 Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examination", S.Chand Publications, 2017.
- Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning",
- 2 S.Chand Publications, 2021.

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21BML51MICROPROCESSOR AND MICROCONTROLLER LABORATORYL T P C0 0 2 1

Preamble:

Microprocessor and Microcontroller laboratory course provides fundamental knowledge on programming of 8086 microprocessor, 8051 microcontroller and ARM processor. The student develops their skills in simple application development using the interfacing of microprocessor and microcontroller.

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

- 1. Experiment & Verify Arithmetic & Logic Operations, Matrix operations, sorting and searching among an array of integers using 8086 microprocessor.
- 2. Experiment & Verify Arithmetic and Logic Operations using 8051 microcontroller.
- 3. Experiment & test interfacing of stepper motor, DC motor, Keyboard and seven segment display interface using 8051 microcontroller.
- 4. Experiment & test Stepper Motor and DC motor interfacing using ARM Processor.
- 5. Experiment & test switch interfacing using ARM Processor.

LIST OF EXPERIMENTS

- 1. Arithmetic, Logic and Matrix operations using 8086 microprocessor.
- 2. Sorting and Searching using 8086 microprocessor.
- 3. Arithmetic and Logic Operations with 8051 microcontroller.
- 4. Block data transfer between internal and external memory including overlapping blocks with 8051 microcontroller.
- 5. Interrupts Handling with 8051 microcontroller.
- 6. Stepper Motor and Speed Control of DC Motor using 8051 microcontroller.
- 7. Square waveform and Saw tooth waveform generation using 8051 microcontroller.
- 8. Keyboard and seven segment display interface using 8051 microcontroller.
- 9. Time delay generation using 8051 microcontroller.
- 10. Stepper Motor interface using ARM
- 11. DC Motor interface using ARM
- 12. Interface a simple Switch and display its status through LED using ARM.

Lecture: 0, Tutorial : 0, Practical:45, Total : 45

21BML52 MEDICAL INSTRUMENTATON LABORATORY - I

Preamble:

The course is designed to make the student acquire an adequate knowledge of record and measure the physiological systems of the human body and relate them to the parameters that have clinical importance.

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

- 1. Record the ECG, EEG and EMG signals using surface electrodes and real time patient monitoring system.
- 2. Measure the blood flow using ultrasonic blood flow meter and Record and measure Galvanic Skin Resistance.
- 3. Experiment and determine the flow rate for safer micro administration of doses.
- 4. Acquire and analyze the characteristics of biosignals using MATLAB and LabVIEW.
- 5. Experiment and verify the hearing acuity using audiometer and measure the lung volumes, lung capacities using spirometry.

LIST OF EXPERIMENTS

- 1. Recording of ECG signal and Analysis.
- 2. Recording of EMG and EEG signal.
- 3. Recording of various physiological parameters using real time patient monitoring system.
- 4. Measurement of Galvanic Skin Resistance (GSR).
- 5. Measurement and recording of peripheral blood flow using blood flow meter.
- 6. Measurement of Flow rate using Syringe pump and Infusion pump.
- 7. Determination of QRS complex by simulating ECG signal using MATLAB.
- 8. Recording and Analysis of ECG signals using LabVIEW.
- 9. Determination of hearing loss by obtaining audiogram using audiometer.
- 10. Analyze the respiratory parameters using Spirometry.

Lecture: 0, Tutorial : 0, Practical:45, Total : 45
21MCL09

COMMUNICATION SKILLS LABORATORY

(Fifth /Sixth Semester)

L T P C 0 0 2 0

Preamble:

Communication Skill is a life skill necessary for all students of Engineering and Technology. The course Communicative Skills Laboratory aims at developing effective oral and written communication to facilitate their success in competitive examinations, and recruitment screening thereby ensuring professional success and progress.

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

- 1. Respond quickly and correctly to questions from different types of scripts, exhibiting good comprehension and analyzing skills
- 2. Participate effectively in formal group discussions and prepare professional e mails, persuasive and expository paragraphs to establish and meet organizational needs and goals.
- 3. Fare well in IELTS and other English language assessment segments of competitive examinations within the stipulated time.
- 4. Write effective resumes, and face interviews with communicative competence and confidence, with a good knowledge of career skills.
- 5. Select appropriate vocabulary and idiomatic expressions, identify errors in syntax, arrange sentences to make meaningful paragraphs, without any aid.

UNIT 1 RECEPTIVE SKILLS

LISTENING & READING – Developing Listening & Reading Skills - Comprehension and Analysis – Listening & Reading for Main Idea - Specific Information - Sequence-Vocabulary - Cultural Interest-Attitude and Opinion-Functional language.

UNIT 2 PRODUCTIVE SKILLS

SPEAKING - Group Discussion skills – Structure- Types- Techniques - Keywords -Vital qualities -Tips to improve performance. **WRITING -** Emails and Paragraph Writing - Expository and Persuasive

UNIT 3 ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS 4 Orientation to International English Language Testing System (IELTS), Public Service Commission Exams (TNPSC,UPSC)

UNIT 4 CAREER SKILLS

Different types of Interview formats - Answering Questions – FAQ"s - Mock Interviews - Body Language - Preparation of Résumé and Job Application Letter - Team Work - Managing Time - Managing Stress -

Negotiation Skills - Networking Professionally - Social Protocols - Upskilling

UNIT 5 VERBAL ABILITY

Synonyms and Antonyms - Verbal Analogy - Cloze Test- Idioms and Phrases - Sentence Completion -Jumbled Sentences - Error Spotting - Theme Detection - Sentence Arrangement

Lecture: 30, Tutorial : 0, Total : 30

RECOMMENDED SOFTWARE: Globerena **REFERENCES:**

- 1. Rizvi M.Ashraf "Effective Technical Communication" MC Graw Hill Education, New Delhi, 2005.
- 2. Koneru Aruna "Professional Communication" MC Graw Hill Education, Chennai, 2008.
- 3. Upadhyay Menasha & Arun Sharma "Comprehension Interpersonal & Communication Skills for General Studies Civil Services Preliminary Examination" MC Graw Hill Education, New Delhi,2012.

e-RESOURCES:

- 1. http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
- 2. https://www.teachingenglish.org.uk/article/email-writing
- 3. https://www.naukri.com/blog/frequently-asked-hr-interview-questions-and-answers/
- 4. http://www.oxforddictionaries.com/words/writing-job-applications
- 5. https://www.fresherslive.com/online-test/verbal-ability-test/questions-and-answers.

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21BMT61

Preamble:

Biomedical Signal Processing provides an introduction to the basic concepts of signal processing methods and to acquire knowledge of analysis of systems using various transformation techniques. It provides students to realize about different filter structure and also to develop algorithm for signal processing. This course gives an in-depth analysis of the origin and processing of bioelectrical signals in humans. The analysis is related to

BIOSIGNAL PROCESSING

differentiating between healthy and pathological conditions and emerges from clinical situations and issues.

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

- 1. Acquire the knowledge of DFT properties and implement DFT using FFT.
- 2. DesignIIR filters using Impulse invariance and Bilinear transformation techniques.
- 3. Design FIR filters using the windowing and sampling techniques.
- 4. Apply the wave detection techniques in ECG signals.
- 5. Analysethe PCG and EEG signals using adaptive segmentat ion technique.

UNIT 1 DISCRETE AND FAST FOURIER TRANSFORM

Introduction to DFT – Efficient computation of DFT – Properties of DFT – FFT Algorithms – Decimation in Time (DIT) and Decimation in Frequency (DIF) Algorithms – Linear and Circular Convolution – overlap saveand add methods.

UNIT 2 IIR FILTER DESIGN

Analog filter design – Discrete time IIR filter from analog filter – IIR filter desgin: Impulse Invariance, Bilinear transformation technique – Realization using Direct form – Cascade and Parallel forms.

UNIT 3 FIR FILTER DESIGN

Linear phase FIR filters – Filter design: windowing techniques (Rectangular Window, Hamming Window, Hanning Window), Frequency sampling techniques – Realization of FIR filters Transversal – Linear phase and Poly phase structures.

UNIT 4 ANALYSIS OF BIOMEDICAL SIGNALS

Nature of Biomedical Signals - Objectives of Biomedical Signal Analysis – Detection of events and waves of P wave and QRS in ECG – Correlation analysis of EEG rhythms – Morphological analysis of ECG signals –analysis of activity – Analysis of Exercise ECG and respiration - Spectral Modelling and Analysis of PCG Signals

UNIT 5 ANALYSIS OF NONSTATIONARY AND MULTICOMPONENT SIGNALS

Time•variant Systems- Fixed Segmentation- Adaptive Segmentation- Wavelets and Time•frequency Analysis-Separation of Mixtures of Signals- Application of Adaptive Segmentation in EEG and PCG Signals

TEXT BOOKS:

- John G. Proakis& Dimitris G.Manolakis, "Digital Signal Processing Principles, Algorithms & Applications",
- ^{1.} Pearson Education / Prentice Hall, Fourth Edition, 2007.
- 2. Rangaraj M Rangayyan, "Biomedical Signal Analysis A Case Study Approach" John Wiley, 2002.

REFERENCÉS:

- 1. Sanjit K.Mitra,"Digital Signal Processing–A Computer Based Approach", Mc Graw Hill, 4thedition 2013.
- 2. Reddy D C, "Biomedical Signal Processing -Principles and Techniques", The McGraw Hill PublishingCompany Limited, New Delhi, 2005.
- 3. Willis J. Tompkins,"Biomedical Digital Signal Processing", Prentice Hall of India Publications, 1995.

e-RESOURCES:

- 1. http://www.nptelvideos.in/2012/12/digital-signal-processing.html, "Digital Signal Processing", Prof. S.CDutta Roy, IIT Delhi.
- 2. http://www.nptelvideos.in/2012/11/digital-signal-processing.html, "Digital Signal Processing", Prof.T.K.Basu, IIT Kharagpur.
- 3. https://nptel.ac.in/courses/108/105/108105101/Biomedical Signal Processing, "Biomedical Signal Processing", Prof.Sudipta Mukhopadhyay, IIT Kharagpur.

Lecture: 45, Tutorial : 15, Total : 60

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MEDICAL INSTRUMENTATION II

21BMT62

Preamble:

This course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance and to understand the fundamental principle and working of the biomedical instruments involved in the measurement.

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

- 1. Describe the key aspects involved in monitoring rhythmic heart function using pacemaker and to relate heart rate to cardiac output using dilution techniques.
- 2. Categorize DC and Implantable defibrillators and working of diathermy using shortwave, microwave, ultrasonic units used for therapeutic purpose of electrotherapy equipment.
- 3. Explain spirometer and ventilator using wedge, ultrasonic and artificial, modern ventilators used for diagnostic and therapeutic function of respiration measurement.
- 4. Illustrate diagnostic function of patient monitoring system and biotelemetry using cardiac, bedside, wireless, single channel, multi channel and implantable units used in ICU Department.
- 5. Identify the need of Infusion pump, lithotripters and anaesthesia machine used for special therapeutic equipment.

UNIT 1 CARDIAC EQUIPMENT AND OUTPUT MEASUREMENT

Cardiac pacemakers - Programmable Pacemakers, Power sources, Types of leads and electrodes, Pacing system Analyzers. Cardiac output measurement – Indicator dilution method, Dye dilution method, Thermal dilution techniques, Measurement of continuous cardiac output.

UNIT 2 ELECTROTHERAPY EQUIPMENT

Cardiac defibrillator- Need for a defibrillator, Implantable defibrillator, defibrillator analyser. Diathermy- Shortwave Diathermy- Ultrasonic Diathermy.

UNIT 3 RESPIRATORY MEASUREMENT SYSTEM

Pulmonary function measurements – Spirometry: wedge spirometer, Ultrasonic spirometer. Ventilators: Artificial ventilation, classification of Ventilators, Pressure-volume-flow diagrams, Modern ventilators.

UNIT 4 PATIENT MONITORING AND BIOTELEMETRY

Patient monitoring systems: Cardiac monitors using digital memory, Bedside patient monitoring systems, Central monitors. Biotelemetry: Wireless telemetry, Single channel telemetry systems, Multichannel wireless telemetry systems, Implantable telemetry systems.

UNIT 5 SPECIAL THERAPEUTIC EQUIPMENT

Infusion pumps, components of drugs infusion systems, Implantable infusion systems, Closed loop control in infusion systems. Lithotripters: First lithotripter machine, Modern lithotripter systems. Anaesthesia machine

Lecture: 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3nd Edition, New Delhi, 2014.
- 2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Bio-Medical Instrumentation and Measurements", Pearson Education, 2nd edition 2005.

REFERENCES:

- 1. Joseph J.carr and John M. Brown, "Introduction to Biomedical equipment technology", John Wiley and sons, New York, 1997
- 2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2010.
- 3. L.A Geddas and L.E.Baker "Principles of Applied Biomedical Instrumentation" 2004.

e-RESOURCES:

- 1. https://www.researchgate.net/journal/08998205 Biomedical Instrumentation Technology
- 2. <u>http://www.omicsonline.org/scholarly/biomedical-instrumentation-journals-articles-ppts-list.php</u>

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21BMT63

Preamble:

This course provides an introduction to biomedical imaging and modern imaging modalities. It enables students to develop an understanding of the physics principles underlying these imaging techniques and an awareness of their clinical applications.

RADIOLOGICAL EQUIPMENT

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

- 1. Describe the physics principles involved in X ray tube based planar imaging equipment.
- 2. Distinguish the generations of Computed tomography scanner in terms of image acquisition and image reconstruction method.
- 3. Articulate the functioning of Magnetic resonance imaging equipment used for visualizing portions in the body.
- 4. Explain the working of imaging equipment used in nuclear medicine department.
- 5. Discuss radiation safety issues in the operation of Radiotherapy equipment"s.

UNIT 1 MEDICAL X-RAY EQUIPMENT

Nature of X-rays- X-production and Interaction with matter, 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, Digital subtraction Angiography, Mammography.

UNIT 2 COMPUTER TOMOGRAPHY

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 3 MAGNETIC RESONANCE IMAGING

Fundamentals of magnetic resonance- Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2, NMR pulse sequences. 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.

UNIT 4 NUCLEAR MEDICINE SYSTEMS

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 5 RADIATION THERAPY AND RADIATION SAFETY

Radiation therapy – linear accelerator, Telegamma Machine. SRS –SRT,-Recent Techniques in radiation therapy -3DCRT – IMRT – IGRT and Cyber knife- radiation measuring instruments-Dosimeter, film badges, Thermo Luminescent dosimeters- electronic dosimeter- Radiation protection in medicine- radiation protection principles.

Lecture: 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. Steve Webb, "The Physics of Medical Imaging", Taylor & Francis, Newyork, 2010.
- 2. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002.
- 3. Faiz M. Khan, John P. Gibbons, "The Physics of Radiation Therapy", WoltersKulwer, Philadelphia, 2010.

REFERENCES:

- 1. Stewart C. Bushong, "Radiologic Science for Technologists", Elsevier Mosby, 2004.
- 2. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine" Third edition Springer, 2006.
- 3. David J Dowsett, Patrick A Kenny and R Eugene Johnston, "The physics of Diagnostic Imaging", Chapman & Hall Medical, 1998.
- 4. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, "Medical physics and Biomedical engineering", Institute of Physics Publishing, Bristol and Philadelphia, 1999.

e-RESOURCES:

1. Edx, <u>https://courses.edx.org/courses/UQx/BIOIMG101x</u>, "Introduction to Biomedical Imaging", Prof. Dr. Graham Galloway, The University of Queensland.

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21MCT07

ARITHMETIC AND ANALYTICAL ABILITY (Common to All Branches in Sixth Semester)

LT PC 2000

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Preamble:

Arithmetic And Analytical Ability evaluates the talent and potential to perform a certain task, with no prior knowledge and/or training. This course deals with sort of problems on dynamic thinking, numeric capacity and spatial question. This course is further used for prediction of future success both in educational and vocational careers and aptitude skills help the students in the proper choice of courses and careers.

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

- 1. Compute time, work, capacity and identify the pattern by analyzing the given problem/scenario
- 2. Analyze the given problem involving mixture, averages, seating arrangement and apply the suitable method to get the appropriate result.
- 3. Interpret the given chart and determine the solution.
- 4. Identify and apply the appropriate permutation, Combination, probability technique to determine the solution.
- 5. Infer the solution for the given scenario involving syllogisms, clocks, calendar using suitable techniques.

UNIT 1

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Time and Work, Pipes and Cisterns, Symbol Series	
UNIT 2	6
Alligation or Mixture, Averages, Seating Arrangements	
UNIT 3	6
Data Interpretation-Table Charts, Bar Charts, Pie Charts, Line Charts	
UNIT 4	6
Permutation and Combination, Probability	
UNIT 5	6
Syllogisms, Clocks, Calendar	

REFERENCES:

Lecture: 30, Tutorial : 0, Total : 30

- 1 Dr.R.S.Aggarwal, "Quantitative Aptitude for Competitive Examination", S.Chand Publications, 2017
- 2 Dr.R.S.Aggarwal, "A Modern Approach to Verbal & Non-Verbal Reasoning",
- ² S.Chand Publications, 2018.

BIOSIGNAL PROCESSING LABORATORY

Preamble:

The Biosignal Processing Laboratory is to give hands on training to the students in understanding the theory of signal processing and practicing the algorithms used in Biosignal processing. This will improve the understanding capability of the Biomedical signal theory and simulation capability of the signal processing algorithms.

- 1. Generate basic signals using Scilab.
- 2. Perform convolution, DFT and FFT operations using Scilab.
- 3. Design FIR and IIR filter for the specification derived from the given problem and simulate the frequency response.
- 4. Design Algorithm to detect the spikes and waves in EEG and the peaks in ECG signals.
- 5. Apply PCA and ICA algorithm in the given biomedical signal.

LIST OF EXPERIMENTS

- 1. Generation of impulse, sinusoidal, saw tooth, square and exponential signals.
- 2. Linear convolution and circular convolution
- 3. Implement DFT and FFT algorithms for the given signal.
- 4. Design of IIR Butterworth filter using bilinear transformation method.
- 5. Design of Chebyshev IIR filter using one to one mapping method.
- 6. Design of FIR filter using Hamming window.
- 7. Detection of the dicrotic notch in the carotid pulse signal.
- 8. Design and Implement the Pan-Tompkins method for QRS detection.
- 9. Design of cross-correlation for EEG spike and Wave detection using template matching.
- 10. Separation of Mixtures of Signals using PCA and ICA.

Lecture: 0, Tutorial : 0, Practical:45, Total : 45

21BML62 MEDICAL INSTRUMENTATION LABORATORY - II L

Preamble:

Medical instrumentation laboratory is structured to train the students in biomedical signal analysis and to develop knowledge of how instrument function concerned with the diagnosis and treatment of diseases.

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

- 1. Experiment and Determine the physiological parameters using real time patient monitoring system.
- 2. Experiment and Determine the flow rate for safer and micro administration of doses.
- 3. Experiment and identify the thermal effect for precise incision using cutting and coagulation modes in surgical diathermy.
- 4. Experiment and verify the hearing acuity using audiometer.
- 5. Acquire and analyze the characteristics of biosignals using MATLAB and LabVIEW.

LIST OF EXPERIMENTS

- 1. Recording of various physiological parameters using real time patient monitoring system
- 2. Study of Shortwave diathermy
- 3. Study of Ultrasonic diathermy
- 4. Determination of QRS complex by simulating ECG signal using MATLAB.
- 5. Perform an Experiment to convert fibrillated rhythmic ECG to normal form using defibrillator.
- 6. Analyze the working of ESU Cutting and Coagulation modes.
- 7. Determination of hearing loss by obtaining audiogram using audiometer.
- 8. Recording and Analysis of ECG signals using LabVIEW.
- 9. Measurement of Flow rate using Syringe pump and Infusion pump.
- 10. Study of Ultrasound Scanner.

Lecture: 0, Tutorial : 0, Practical:45, Total : 45

MINI PROJECT

Preamble:

The Course enables the students to estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical/ Electronics/ Mechatronics/ Instrumentation system.

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

- 1. Formulate a real world problem, identify the requirement and develop the design solutions.
- 2. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- 3. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- 4. Express the technical ideas, strategies and methodologies.
- 5. Prepare report and present the oral demonstrations.

ECONOMICS AND MANAGEMENT FOR ENGINEERS

Preamble:

21ITT71

The main aim of this course is to understand the concepts of Economics with respect to the demand and supply analysis. This course makes the students to analyze the theory of production and the analysis of the cost parameter by using the Elasticity. This course will enable the students to manage and plan the situation with the help of the available strategies to support the decision making process.

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

- 1. Summarize how to solve economics principles to solve economic problems in engineering discipline by satisfying the economic laws.
- 2. Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity.
- 3. Interpret short run and long run costs in the process of production for carrying out a business.
- 4. Apply managerial skills to make decisions and solve problems for achieving organizational objectives.
- 5. Express the principles of effective planning for survival and success of all organizations using standing and single use planning methods.

UNIT 1 INTRODUCTION TO ECONOMICS

Introduction to Economics – Scope of Economics – Positive and Normative Science – Methodology of Economics – Economic Laws - Economy and its basic problems: Economy and its working – Kinds of economy systems – Basic problems of economy.

UNIT 2 DEMAND AND SUPPLY ANALYSIS

The Law of Demand – The Law of Supply – Elasticities of Demand and Supply: Price Elasticity of Demand - Price Elasticity and Consumption Expenditure- Cross Elasticity of Demand – Income Elasticity of Demand – The Elasticity of Price Expectations – The uses of Elasticity–Price Elasticity of Supply.

UNIT 3 THEORY OF PRODUCTION AND ANALYSIS OF COST

Meaning of Production – Production concepts – Production Function – Laws of Production – Cost Concepts - Short-Run Cost Output Relations – Long Run Cost output relations – Economics of Scale.

UNIT 4 INTRODUCTION TO MANAGEMENT

Management: Overview – Management Defined – Managerial skills – Managerial roles – Management responsibilities – Management functions. Evolution of Management: Classical approaches to Management – Contemporary Management Perspectives.

UNIT 5 PLANNING

Planning and Forecasting: Importance of Planning – Principles of effective Planning – Planning process – Types of Plans. Strategic Planning: Strategic Planning process – Rational decision making.

Lecture: 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. D.N.Dwivedi, "Principles of Economics", Second Edition, Vikas Publishing House (P) Limited, New Delhi, 2012.
- 2. J.S.Chandan, "Management Concepts and Strategies", Vikas Publishing House (P) Limited, New Delhi, 2003. **REFERENCES:**
- 1. RanbirSingh," Principles of Engineering Economics and Management", S.K.Kataria& Sons, New Delhi, 2013.
- 2. Manish Varshney and VidhanBanerjee, "Engineeringand Managerial Economics", First Edition, CBS Publishers and Distributors Pvt. Ltd., 2015.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/110101005/, Prof.Trupti Mishra, S.J.M. School of Management, IIT Mumbai, Managerial Economics.
- 2. https://nptel.ac.in/courses/122106031/slides/3_1s.pdf, Dr.M.Thenmozhi, Professor, IIT Madras.

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21HST71

HUMAN VALUES AND PROFESSIONAL ETHICS

(Common to all B.E/B.Tech Programmes)

Preamble:

Universal Human Values is a life skill necessary for all students of Engineering and Technology. The course aims to identify the values and skills, and to realize the need, basic guidelines, content and process of value education. Professional Ethics For Engineers deals with the human values, integrity and work ethics in the common world. This course is mainly concerned about the theories of ethics, which form the basis for the understanding and responsibility of the various groups encountered in Engineering.

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

- Relate the significance of value inputs in a classroom and start applying them in their life and 1. profession.
- 2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual.
- Interpret the value of harmonious relationships based on the trust and respect in their life and 3. profession.
- Discuss the ethical issues related to Engineering. 4.
- 5. Discuss Engineer's work in the context of its impact on society.

INTRODUCTION TO UNIVERSAL HUMAN VALUES UNIT 1

Understanding the need, basic guidelines, content and process for Value Education. Self Exploration-Mechanism for self exploration. Continuous Happiness and Prosperity- Basic Human Aspirations and its requirements for fulfillment of Human Aspirations understanding and living in harmony at various levels. 9

UNIT 2 HARMONY IN ONESELF, FAMILY AND SOCIETY

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationships. Trust and Respect- values of relationship. Difference between intention and competence. Difference between respect and differentiation

HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL UNIT 3 **ETHICS**

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics. Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models.

UNIT 4 ENGINEERING ETHICS

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 -Professional responsibility - Moral reasoning - Theories about right action - Self interest - Self respect - Duty ethics - Customs and religion.

UNIT 5 ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation – Engineers as responsible experimenters – Role of codes- Codes of Ethics - Sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE) - A balanced outlook on law - Safe exits - The Bhopal gas tragedy and Challenger case study.

TOTAL : 45 PERIODS

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TEXT BOOKS:

- 1. Gaur R R, Sangal R, Bagaria G P, "A Foundation Course in Human Values and Professional Ethics". 2009
- 2. Govindarajan M, Natarajan S and Senthil Kumar V. S, "Engineering Ethics", PHI Learning Pvt. Ltd, New Delhi, 2017.

REFERENCES:

- 1. Banerjee B P, "Foundations of Ethics and Management", Excel Books. 2005.
- 2. Bajpai B L, "Indian Ethos and Modern Management", New Royal Book Co., Lucknow. Reprinted 2008.
- 3. Subramanian R, "Professional Ethics", Oxford university press, 2017.

e-RESOURCES:

- 1. https://www.uhv.org.in/
- 2. <u>https://nptel.ac.in/courses/109/106/109106117/</u>

21BMT72

DIGITAL IMAGE PROCESSING

Preamble:

To provide the knowledge about image fundamentals, mathematical transforms, image enhancement techniques, restoration procedures, and segmentation techniques, image compression methods and to familiarize the concepts on various image representation and image recognition methods.

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

- Illustrate the image formation and color models with image sampling and quantization methods. 1.
- Analyze intensity transformation techniques to enhance the images in spatial and frequency domain. 2.
- 3. Develop an algorithms employed for segmentation and restoration of images using spatial filtering techniques.
- Categorize compression methods to decompose the images using wavelets and arithmetic and Huffman 4. coding techniques.
- Interpret the image representation methods and apply pattern recognition based on matching algorithm. 5.

UNIT 1 **DIGITAL IMAGE FUNDAMENTALS**

Introduction - Origin - Fundamental Steps in Digital Image Processing - Components - Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, Color models - RGB color model - CMY and CMYK color models - HIS color model.

UNIT 2 **IMAGE ENHANCEMENT**

Spatial Domain: Basic intensity transformation, Histogram processing, fundamentals of Spatial Filtering, Smoothing and Sharpening Spatial Filtering. Frequency Domain: Sampling -Fourier Transform - Sampling theorem and aliasing, DFT, Smoothing and Sharpening in the frequency domain filters.

IMAGE SEGMENTATION AND AND IMAGE RESTORATION UNIT 3

Fundamentals, Point, line and Edge detection, Thresholding, Region Based segmentation, Morphological processing- erosion and dilation. Noise models - Mean Filters - Order Statistics - Inverse Filtering - Wiener filtering,

UNIT 4 WAVELETS AND IMAGE COMPRESSION

Wavelets - Subband coding - Haar Transform, Multiresolution expansions. Compression: Fundamentals -Image compression standards- Coding: Run length – Huffman – Arithmetic - Bit plane – predictive and wavelet. 9

UNIT 5 **IMAGE REPRESENTATION AND RECOGNITION**

Boundary representation - Chain Code - Polygonal approximation, signature, boundary segments - Boundary description - Shape number - Fourier Descriptor, moments- Regional Descriptors - Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Lecture: 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education Asia, Fourth 1. Edition. 2018.
- 2. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2nd edition 2015.

REFERENCES:

- 1. William K. Pratt, "Digital Image Processing: PIKS Scientific Inside", Wiley Student Edition, 2010.
- 2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2011.
- 3. Munesh.C. Trivedi and Dr. Sanjay. M. Shah, "Digital Image Processing", Khanna publications, 2007
- 4. Milan Sonka, Roger Boyle and Vaclav Hlavac, —Image Processing, Analysis, and Machine Vision^{II}, 4th Edition, Cengage Learning, 2015

e-RESOURCES:

- 1. http://nptel.ac.in/courses/106105032/, "Digital Image Processing", Prof.G. Harit, Indian Institute of Technology, Kharagpur.
- 2. https://nptel.ac.in/courses/117/105/117105079/

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21MCT08 INDIAN CONSTITUTION AND TRADITIONAL KNOWLEDGE LTPC

Preamble:

The course provides basic information on Indian Constitution and Indian Traditional knowledge. This is essential for all citizens and especially for engineers so that they become aware of Indian polity and governance. This also reminds the citizen about their obligation, adherence and up keeping of Constitutional rights.

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

- 1. Outline the evolution of Indian constitution and Federal structure
- 2. List and explain the functions of Centre, States and District Administrations
- 3. Elaborate the roles of Panchayat raj
- 4. Explain the powers and roles of Election Commission
- 5. Illustrate the Indian traditional knowledge and elucidate their recovery

UNIT 1

Constitution" meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy - Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

UNIT 2

Governor: Role and Position, CM and Council of ministers, State Secretariat: organisation, Structure and Functions District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation,

UNIT 3

Panchayatraj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT 4

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

UNIT 5

Basic structure of Indian Knowledge System-Modern Science and Indian Knowledge –Philosophical Tradition - Indian Linguistic Tradition (Phonology, morphology, syntax and semantics) – Indian Artistic Tradition

Lecture: 30, Tutorial : 0, Total : 30

- TEXT BOOKS:
- 1. M.Rajaram, Indian Constitution, New Age International, 2009
- V. Sivaramakrishnan (Ed.) Cultural Heritage of India (Course Material), Bharatiya Vidya Bhavan, Mumbai. 5thEdition, 2014

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21BML71 DIGITAL IMAGE PROCESSING LABORATORY

Preamble:

The goals are to supplement the theory course that provides digital image processing concepts for the students to develop an application software program in MATLAB/Scilab. It also demonstrates the image transformation, enhancement, segmentation techniques and different texture analysis techniques with associated programs.

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

- 1. Develop a program using digital image processing concepts to perform filtering operations for the given image.
- 2. Create an algorithm using intensity transformation and analyze the characteristics of the given image.
- 3. Develop a program to analyze the texture of digital image using statistical properties.
- 4. Apply segmentation and thresholding technique to obtain region of interest of a digital image.
- 5. Construct an algorithm for multimodal biometric security and safety applications.

LIST OF EXPERIMENTS

- 1. Perform digital Image fundamental operations -Resizing, Cropping, Image conversion and basic arithmetic operations.
- 2. Develop an algorithm for Image Enhancement using histogram equalization.
- 3. Implement DFT analysis of digital images using masking operation.
- 4. Apply Gray level transformation in spatial domain.
- 5. Preform the Image Transformation in frequency domain using transforms.
- 6. Create an algorithm to segment an image using edge detection, line detection and boundary detection.
- 7. Perform the Morphological Operations of digital image using Dilation, Erosion and Opening, Closing.
- 8. Perform Thresholding Functions using optimal threshold & Otsu"s Technique.
- 9. Analysis of images with HSI, RGB and CMYK color models.
- 10. Implement a program to analysis of digital image texture with statistical properties.

Mini Project

Applications to biometric and security

Software

MATLAB/Scilab

Lecture: 0, Tutorial : 0, Practical:45, Total : 45

Hospital Training

Preamble:

To develop the practical experience at place where biomedical equipment's are utilized.

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

- 1. Implement a patient-centred approach in healthcare
- 2. Communicate with other health professionals in a respectful and responsible manner
- 3. Demonstrate the maintanence and service of diagnostic and therapeutic equipments.
- 4. Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs.
- 5. Demonstrate patient care in hospital setting and provide access to health care professionals to get a better understanding of their work

LIST OF EXPERIMENTS

- 1. Study of Ventilator functioning.
- 2. Study of Ultrasound machine.
- 3. Study of Heart Lung Model.
- 4. Troubleshooting, maintenance and servicing of medical equipments.
- 5. Presentation on various departments and equipments in the Hospital.

Students have to undergo two weeks practical training in hospitals with the prior approval from the institution during semester holidays of that particular academic year. At the end of the training student will submit a report as per the prescribed format to the department.

TOTAL:45 PERIODS

INTERNSHIP

Preamble:

To develop the practical experience and expose real time knowledge based on industrial needs. **General Instruction**

A student has undergo full time Internship in an organisation during the eighth semester provided that the student has already completed all the theory course requirements upto 7th semester as in Clause 4.5. In this case, the student in 8th semester, has to submit the project report based on the internship experience. The format of the report shall be the same as that prescribed for the programme and should have a certificate signed by a competent person from the organisation along with an attendance certificate. In addition, the student has to attend all the Project Reviews conducted by the Department along with the other students periodically.

PROJECT WORK

Preamble:

This course is designed to develop the ability to solve a specific problem right from its identification and literature review till the successful solution for the same. This course also trains the students in preparing project reports and in facing reviews and viva voce examination.

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

- 1. Discover potential research areas in the field of Biomedical Engineering.
- 2. Compare and contrast the several existing solutions for the problems identified.
- 3. Formulate and propose a plan for creating a solution for the research plan identified.
- 4. Conduct the experiments as a team and interpret the results.
- 5. Report and present the findings of the work conducted.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee shall be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department. Progressive weightage shall be assigned to the project reviews as decided by the project review committee.

TOTAL: 180 PERIODS

BIOSENSORS AND TRANSDUCERS

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Preamble:

Biosensors and Transducers course presents the rapidly evolving methodologies that are relevant to biosensors and transducers fabrication and characterization. It provides a comprehensive understanding of the functionality of biosensors and electrical transducers.

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

- 1. Describe the principle, components and classification of Biosensors.
- 2. Identify and explain the fabrication techniques and analytical characteristics of electrochemical sensors.
- 3. Develop an appropriate protocol for identifying biomarkers using enzymatic biosensors
- 4. Apply the immunological reactions for designing novel diagnostic techniques.
- 5. Explain the properties and characteristics of materials used in electrical transducers

UNIT 1 Introduction to Biosensors

Basic principle of a biosensor, Components of a biosensor, Molecular recognition, Classification of biosensors based on transducers, Piezoelectric biosensors, Magneto elastic biosensors, Field effect transistor-based biosensor, Calorimetric biosensor, Noninvasive biosensors

UNIT 2 Electrochemical biosensors

Electrochemical techniques, Electroanalytical characteristics of biosensors, Membranes used in biosensors for selectivity, Biosensor electrode fabrication techniques

UNIT 3 Enzymatic Biosensors

Enzymatic biosensors, Enzymatic and nonenzymatic biosensors for various diseases, Biomarkers for diagnosis of diseases, Glucose oxidase-based glucose biosensors for diabetes: Noninvasive glucose biosensor, Implantable glucose biosensors. Cholesterol biosensor, Oxidative stress biomarkers. Biomedical applications of enzyme biosensors.

UNIT 4 Immunosensors

Introduction, Antibody as biorecognition element, Types of antibodies and antibody fragments, Types of immunosensors, Labeled and label-free immunosensors, Immunosensor applications.

UNIT 5 Electrical transducers

Passive electrical transducers: Resistive transducaers, inductive transducers, capacitive transducers. Active Electrical transducers: Thermoelectric transducers, Piezoelectric transducers, Photoelectric transducers, Ionization transducers, Electrochemical tranducers

TOTAL :45 PERIODS

TEXT BOOKS:

- Chandran Karunakaran Kalpana Bhargava Robson Benjamin, Biosensors and Bioelectronics, 1st Edition, Hardcover ISBN: 9780128031001, Imprint: Elsevier, Published Date: 29th July 2015.
- 2. DVS Murty, Tranducers and Instrumentation, second edition, , PHI learning Private Limited, 2012

REFERENCES:

- 1. Keith Brindley, Sensors & Transducers, Heinemann Newnes, Great Britain, 1988
- 2. Harry Thomas, Handbook of Bio medical Instrumentation, Reston, Virginia 2000
- 3. Xueji Zhan , Electrochemical Sensors, Biosensors and their Biomedical Applications 1st Edition ,

e-RESOURCES:

- 1. https://www.journals.elsevier.com/biosensors-and-bioelectronics
- 2. https://www.elprocus.com/electrical-transducer-working/

Preamble:

To peruse sensors principles with the technological difficulties and their application in wearable systems.

WEARABLE SYSTEMS

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

- 1. Identify the wearable sensors and its need for wearable systems.
- 2. Interpret the energy requirement for wearable system.
- 3. Manipulate the need for wireless communication techniques.
- 4. Predict the wearability issues related to Body Sensor Networks.
- 5. Illustrate the applications of wearable systems

UNIT 1 INTRODUCTION TO SENSORS FOR WEARABLE SYSTEMS

Need for wearable systems, Characteristics of wearable systems, Sensors for wearable systems-Biomechanical Sensors -Inertia movement sensors, Physiological Sign Sensors -Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Pulse Oximetry, Radiant thermal sensor, Gas Sensor, Bio compatibility.

UNIT 2 ENERGY HARVESTING FOR SELF-POWERED WEARABLE DEVICES

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT 3 WIRELESS COMMUNICATION TECHNOLOGIES FOR WEARABLE 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 4 ERGONOMICS FOR WEARABLE BODY SENSOR NETWORKS

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, Rejection of irrelevant information, Data mining.

UNIT 5 APPLICATIONS OF WEARABLE SYSTEMS

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

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

e-RESOURCES:

1. https://www.youtube.com/watch?v=P7YWJuhVM1Q, "Wearable Electronic Textiles",Prof. Volakis, Chair Professor of Electrical Engineering at Ohio State University.

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Preamble:

To impart the knowledge on electromechanical units which will assist and restore normal functional ability of particular organ that is defective temporarily or permanently.

HUMAN ASSIST DEVICES

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

- 1. Interpret the various mechanical techniques that will help in assisting the heart functions.
- 2. Explain the working principles and parameters of the dialysis unit.
- 3. Indicate the methodologies to assess the hearing loss.
- 4. Infer the various orthotic devices and prosthetic devices to overcome orthopedic problems.
- 5. Discuss the sensory impairments and its substitutions .

UNIT 1 CARDIAC ASSIST DEVICES

Principle of External counter pulsation techniques, intra-aortic balloon pump, Cardiac catheterization, cardio pulmonary resuscitation, prosthetic heart valves.

UNIT 2 HEMODIALYSERS

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyzer monitoring and functional parameters.

UNIT 3 HEARING AIDS

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT 4 PROSTHETIC AND ORTHODIC DEVICES

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices

UNIT 5 SENSORY AUGUMENTATION AND SUBSTITUTIONS

Classification of visual impairments, Prevention and cure of visual impairments, Visual augmentation, Tactile vision Substitution, Auditory substitution and augmentation, Assistive device for visual impaired.

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1. John G.Webster "Encyclopedia of medical devices and instrumentation " Vol.II, III ,IV,V , Wiley Interscience.
- 2. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

REFERENCES:

- 1. Paul A. Iaizzo "Hand book of cardiac Anatomy, Physiology and Devices" Second Edition, Springer.
- 2. Jeffrey H. Shuhaiber, "Ventricular assist devices" Intech publications.

e-RESOURCES:

- 1. https://www.youtube.com/watch?v=1mu6C288ZQ8, "Mechanical circulatory support" by Dr.Arie Blitz MD Harrington Mclaughiln heart and vascular institute, University hospitals.
- 2. https://www.youtube.com/watch?v=fKlY2SKi_dk," Hemodialysis" Dr.Kevin Nash , Well bound of Evanston in Skokie, Illinois.

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VIRTUAL REALITY IN MEDICINE

Preamble:

21BME14

This course aims 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.

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

- 1. Comprehend and appreciate the significance and role of this course in the present contemporary world.
- 2. Understand the basic concepts of Virtual reality.
- 3. Expose the concept of Virtual Reality Programming with toolkits.
- 4. Design of various modeling concepts.
- Develop the Virtual Reality applications in different areas. 5.

UNIT 1 INTRODUCTION

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 2 MODELING

Geometric modeling - kinematics modeling - physical modeling - behavior modeling - model management.

UNIT 3 HUMAN FACTORS

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 4 VR PROGRAMMING

Introducing Java 3D-loading and manipulating external models-using a lathe to make shapes. 3D Sprites- animated 3D sprites-particle systems.

UNIT 5 APPLICATIONS

Medical applications - robotics applications - Advanced Real time Tracking - other applications games, movies, simulations, therapy, Virtual and Augmented reality in medicine - Multipurpose virtual reality environment for biomedical and health applications.

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., 2017.
- 2. William R.Sherman, Alan B.Craig, "Understanding Virtual Reality - Interface, Application, Design", The Morgan Kaufmann Series, 2013.

TOTAL: 45 PERIODS

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21BME15 OPHTHALMOLOGY AND DENTISTRY EQUIPMENTS

Preamble The modern equipments used in dentistry and ophthalmology makes treatment easier. The knowledge helps to support diagnostic and therapeutical purposes.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Understand the knowledge about optics.
- 2. Discuss the ophthalmology equipments.
- 3. Explains about the instruments in ophthalmology.
- 4. Deals about the imaging technique of dentistry.
- 5. Explains about the instruments used for dental purposes.

UNIT 1 PHYSIOLOGICAL OPTICS

General concepts of eye as refractive apparatus, Cornea and lenticular system, Optical resolution of the eye, Visual Angles, Visual Acuity & Axis, Optical Aberrations of the eye, Introduction to refractive errors (myopia, Hypermetropia, Astigmatism, Anisometropia and Anisiekonia, Presbyopia, Retinoscopy, Subjective Examination, Ophthalmoscopy, Principles of Eye Procedures: Tonometry, Contact lenses, LVA.

UNIT 2 OPHTHALMOLOGY EQUIPMENTS

Ophthalmoscope, Retinoscope, Indirect Ophthalmoscope, Slit Lamp in ophthalmology, Keratometer, Maintence of Opthalmic Surgical Instruments.

UNIT 3 OPHTHALMIC INSTRUMENTS

Ophthalmic equipments, Conjunctival Smear, Flourescein Staining, PH testing, Refractometer, Auto refractor, Foci meter, Anaesthesiometry, Dark adaptometry, A& B Scan, Ophthalmic photography, Fundus photography, Fundus Flourescein Angiometry.

UNIT 4 DENTAL RADIOGRAPHY

Foundation of radiography, Discovery of X-radiation, Radiation physics, The Dental X-ray machine, X-ray production. Dental chair system, Lighting system, Trolley or delivery system, Tumbler and spittoon system, spare parts.

UNIT 5 DENTISTRY INSTRUMENTATION

Lasers in Dentistry, Dental equipment repair and maintenance, Handpieces, Burs and rotary attachment, Tooth numbering system, Infection control in dentistry, Instruments used in periodontal Procedures & Basic Restoration procedures.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1 Dr. L.P. Agarwal, "Principles of optic & Refraction 6th Edition, CPS publishers and distributors, 2019.
- 2 H.V. Nema, Nitin Nema, "Textbook of Ophthalmology, 6th Edition, Jaypee Brothers Medical Publishers Limited, 2019.
- 3 V.Srinivasan, R.D.Thulasiraj, "Ophthalmic Instrumnets and Equipments, A handbook on care & Maintenance", Sri aurobindo publications, Second edition 2003.

4 Dr.A.K.Khurana, "Text Book of Ophthalmology, First Edition, New Age International Publishers, 2020.

REFERENCES:

- 1 Dr.A.K.Khurana , "Theory and Practice of Squint & Orthoptics" 3rd Edition, CPS publishers and distributors, 2018.
- 2 William W. Parson, "Modern Optical Spectroscopy: With Exercises and Examples from Biophysics and Biochemistry", Springer, 2nd Edition, 2009.
- 3 Nikolai V. Tkachenko, "Optical Spectroscopy: Methods and Instrumentations", Elsevier, 5th Edition, 2006. e-RESOURCES:
 - 1 https://onlinecourses.nptel.ac.in/noc20 bt16/
 - 2 <u>https://onlinecourses.nptel.ac.in/noc22_ge09</u>

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- 3.
- VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

Preamble This course provide the students to acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance and to understand the fundamental principle and working of the critical care and operation theatre equipments involved in the measurement.

Course Outcomes: Upon completion of this course, students will be able to:

- Perform continuous monitoring and identify the need of Infusion pump & syringe pumps. 1.
- Articulate the functions of dialyzer principle and other critical care equipments. 2.
- Express the basics of operation theatre equipment's and special diagnostic devices its application 3. in medicine.
- 4. Describe surgical applications of lasers.
- Outline the importance of patient safety against electrical hazard. 5.

ICU EQUIPMENT UNIT 1

Suction apparatus, Different types; ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements - SXA - DXA - Quantitative ultrasound bone densitometer.

CRITICAL CARE EOUIPMENT UNIT 2

Hemo dialysis Machine - Different types of Dialyzers, Membranes, Machine controls and measurements, Peritoneal Dialysis, Heart Lung Machine - different types of oxygenators, peristaltic pumps, Incubators, High flow Cannula Therapy.

OPERATION THEATRE EQUIPMENT UNIT 3

Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator, Instruments for operation. Anesthesia Equipment – Humidification, Sterilization aspects- Sterilizers – Chemical, Radiation, Steam for small and large units, Scavenging system- Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, - surgical microscope. 9

UNIT 4 SURGICAL THERAPEUTIC APPLICATIONS OF LASERS

Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering. Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laparoscopy, Otoscopes.

UNIT 5 PATIENT SAFETY

Patient electrical safety – Types of hazards – Natural protective mechanisms against electricity – Leakage current - Inspection of grounding and patient isolation, Hazards in operation rooms - ICCU and IMCUs - Opto couplers and Pulse Transformers.

TEXT BOOKS:

- 1. John G. Webster, "Medical Instrumentation Application and Design", Wiley India Pvt. Ltd, New Delhi, 4th edition, 2015
- 2. Khandpur.R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd edition, 2014.

REFERENCES:

- Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice Hall of India, New Delhi, 2nd 1. edition, 2015
- 2. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merril Publishing Company, 1990.
- L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd edition, 2008.
- Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill, 2003 4.

21BME16

Lecture : 45, Tutorial : 0, Total : 45

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5. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012

e-Resources:

- 1. ps://www.eintegrity.org/e-learning-healthcare-course/intensive-care-medicine.htm
- 2. https://www.medicalmagazine.in/surgical-operating-theatre-the-heart-of-hospital/

VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

21BME17

Preamble

To understand the medical device standards, requirements and design procedure of medical devices and to describe about the design realization, validation and verification of various medical devices.

MEDICAL DEVICE DESIGN

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Define the medical devices standards and requirements.
- 2. Summarize the concept of medical device development
- 3. Recall the engineering design and project metrics
- 4. Demonstrate the testing and validation of medical equipment.
- 5. Interpret the various design transfer and manufacturing methods

UNIT 1 NEEDS FINDING AND CONCEPT GENERATION

Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping – final concept selection. Safety and Risk Management - Tools, Documents and Deliverables

UNIT 2 INTRODUCTION TO PROTOTYPE & DATA FORMATS

Fundamentals of Rapid Prototyping – Classification of Rapid Prototyping Systems – STL Format – STL File Problems – Consequences of Building a Valid and Invalid Tessellated Model – STL File Repair

UNIT 3 DESIGN ENGINEERING

Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.

UNIT 4 TESTING AND VALIDATION

Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

UNIT 5 DESIGN TRANSFER AND MANUFACTURING

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.

TEXT BOOKS:

- 1. Zenios, Makower and Yock, —Biodesign The process of innovating medical technologies^{II}, Canbridge University Press, 2009.
- 2. Theodore R. Kucklick , The Medical Device R&D Handbook, Second Edition, CRC Press, 2012.
- 3. Peter Ogrodnik, Medical Device Design Innovation from Concept to Market, Elsevier, 2013.
- 4. Chua C.K., Leong K.F. and Lim C.S., "Rapid Prototyping: Principles and Applications", Second Edition, World scientific publications, 2003.

REFERENCES:

- 1. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design, 2ndedition, 2005.
- 2. Gail Baura, Medical Device Technologies: A Systems Based Overview Using Engineering, Elsevier science, 2012.
- 3. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau'Handbook of Human Factors in Medical Device Design', CRC press, 2010.

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Total: 45

SPEECH PROCESSING

This course highlights the central role of speech processing in modern speech communication research and applications. It presents a comprehensive overview of digital speech processing that ranges from the basic nature of the speech signal, through a variety of speech analysis, speech modeling and automatic synthesis and recognition of speech signals.

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

- Understand the production and classification of speech signal processing using articulatory and acoustic 1. phonetics.
- 2. Analyze the speech signal using feature extracting and pattern comparison techniques.
- Evaluate the speech processing systems using deterministic and stochastic process models. 3.
- Analyze the continuous speech recognition system using its architecture, acoustic and language models. 4.
- 5. Analyse the speech synthesis using Diaphone Waveform synthesis techniques and evaluation

UNIT 1 **BASIC CONCEPTS**

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 2 SPEECH ANALYSIS

Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures- mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering,

Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT 3 **SPEECH MODELLING**

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

UNIT 4 SPEECH RECOGNITION

Large Vocabulary Continuous Speech Recognition: Architecture of large vocabulary continuous speech recognition system - acoustics and language models - n-grams, context dependent sub-word units; Applications and present status.

UNIT 5 **SPEECH SYNTHESIS**

Text Normalization - Phonetic Analysis - Prosodic Analysis - Diaphone Waveform synthesis - Unit selection synthesis and Evaluation

TEXT BOOK:

- 1. Lawrence Rabiner, Biing-Hwang Juang and Yegnararayana, "Fundamentals of Speech Recognition", Pearson Education, First edition, 2008.
- Daniel Jurafsky and James H Martin, "Speech and Language Processing An Introduction to Natural Language 2 Processing, Computational Linguistics, and Speech Recognition", Pearson Education, second edition 2013.

REFERENCES:

- Thomas F Quatieri, "Discrete-Time Speech Signal Processing Principles and Practice", Pearson Education, 1. 2004.
- Ben Gold and Nelson Morgan, "Speech and audio signal processing, Processing and Perception of Speech and 2. Music", Wiley-India Edition, 2006.
- 3. Lawrence R. Rabiner, Ronald W. Schafer, "Digital Processing of Speech Signals", Prentice-Hall, 1978.
- Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press, 1997. 4.

e-RESOURCES:

- http://freevideolectures.com/Course/2504/ELEC9344-Speech-and-Audio-Processing, "Introduction to speech 1 processing", Prof. E. Ambikairajah, The University of New South Wales.
- http://www.nptelvideos.in/2012/12/digital-voice-and-picture-communication.html, "Lecture Series on Digital 2. Voice and Picture Communication", Prof.S. Sengupta, Department of Electronics and Electrical Communication Engg, IIT Kharagpur.

TOTAL: 45 PERIODS

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Preamble:

To impart the knowledge on design of biometric systems and the underlying trade-offs and to enable the students to understand the technologies in fingerprint, iris, face and speech.

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

- **Infer** knowledge on biometric authentication system and applications of biometric systems. 1.
- Explain the functional description of fingerprint enhancement, feature extraction, classification and 2. matching technique.

BIOMETRIC SYSTEMS

- 3. Discuss about various classifiers, algorithm, feature extraction of face and hand geometry recognition.
- 4 Describe about iris recognition.
- Identify issues in the voice scan and multimodal biometrics. 5.

INTRODUCTION TO BIOMETRICS UNIT 1

Introduction and back ground - biometric technologies -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 2 FINGERPRINT TECHNOLOGY

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

UNIT 3 FACE RECOGNITION AND HAND GEOMETRY

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. 9

UNIT 4 **IRIS RECOGNITION**

Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Da ugman and Wilde, s approach, Iris matching, Iris scan strengths and Weaknesses, System performance, future directions.

UNIT 5 **VOICE SCAN AND MULTIMODAL BIOMETRICS**

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.

TOTAL: 45 PERIODS

TEXT BOOKS:

James Wayman, Anil Jain, DavideMaltoni, Dario Maio, "Biometric Systems, Technology Design and 1. Performance Evaluation", Springer, 2005.

REFERENCES:

- 1 st G.R.Sinha, SandeepB.Patel, "Biometrics:Concepts and Applications", Wiley Publicatios, 1. edition.2013.
- 2. Arun A Ross, KarthikNandakumarand Anil K.Jain, "Handbook of Multibiometics", Springer, 2006. e-RESOURCES:
- http:// nptel/biometrics- iit-kanpur, "Biometric Systems", Prof. PhalguniGupt, IIT, khanpur. 1.

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COMPUTER VISION

21BME23 Preamble

To learn and understand the concepts of three-dimensional image formation and motion analyses of medical images.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Demonstrate basics of image acquisition and processing.
- 2. Analyze the various segmentation process.
- 3. Interpret the motion of image frames.
- 4. Analyze 3D image reconstruction and recognition.
- 5. Identify the applications of related techniques.

IMAGE FORMATION & PROCESSING UNIT 1

Introduction - Photometric image formation - Point operators - Linear filtering - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization - Application. 9

UNIT 2 SEGMENTATION AND FEATURE ALIGNMENT

Feature detection: Points and patches - Edges - Lines. Segmentation - Active contours: Snakes, Scissors - Split and merge: Region splitting and Merging - Mean shift and mode finding. Feature-based alignment: 2D and 3D featurebased alignment - Pose estimation - Geometric intrinsic calibration

UNIT 3 STRUCTURE AND MOTION

Two-frame structure from motion - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT 4 **3D RECONSTRUCTION**

Active range finding - Surface representations - Point-based representations - Volumetric representations - Modelbased reconstruction. View interpolation - Layered depth images. Recognition: Object detection - Face recognition - Instance recognition - Category recognition

UNIT 5 **APPLICATIONS OF MEDICAL IMAGE**

Medical image Segmentation - Gesture Recognition, Motion Estimation and Object Tracking. Case study: Computer Vision for Predictive Analytics and Therapy for Dermatology.

Lecture: 45, Tutorial: 0, Total: 45

TEXT BOOKS:

- 1. E. R. Davies, —Computer & Machine Vision, Fourth Edition, Academic Press, 2012.
- 2. David Forsyth and Jean Ponce – Computer Vision – A Modern Approach, Pearson (November 21st 2011) -Copyright © 2012.

REFERENCES:

- 1. R. Szeliski, —Computer Vision: Algorithms and Applications, Springer 2011.
- 2. Simon J. D. Prince, -Computer Vision: Models, Learning, and Inferencel, Cambridge University Press, 2012.

e-Resources:

- Computer Vision and Image Processing Fundamentals and Applications Course (nptel.ac.in) 1.
- Modern Computer Vision Course (nptel.ac.in) 2.

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VIRTUAL INSTRUMENTATION

Preamble

21BME24

To impart the knowledge on basics, programming techniques, data acquisition concepts of virtual instrumentation and its uses for different applications. Also to make the Students Certified in CLAD (Level I) Examination. **Course Outcomes:** Upon completion of this course, students will be able to:

- 1. Explain the basics concepts in virtual instrumentation
- 2. Demonstrate the programming concepts in virtual instrumentation
- 3. Develop an ability for programming in LabVIEW using loops and structures
- 4. Discuss how to configure the related hardware like DAQ and transducers
- 5. Apply virtual instrumentation concept for various applications

UNIT 1 BASICS OF VIRTUAL INSTRUMENTATION

Introduction- Virtual Instrument versus Traditional Instrument, Advantages, Comparison of Graphical Programming and Textual Programming-LabVIEW environment: Front Panel, Block Diagram, Data Flow techniques.

UNIT 2 PROGRAMMING PRINCIPLES

Creating simple VI- Data types-Numeric, String, Boolean-Mechanical Operation of Boolean, Arrays, Clusters, Waveforms graphs and waveform charts - Array Functions- Cluster Functions- Debugging Techniques, Documentation, Context Help Window-Sub VI-Creation.

UNIT 3 LOOPS AND STRUCTURES

FOR - WHILE loop - Case, Sequence, event structures- Formula nodes- local and global variables.

UNIT 4 DATA ACQUISITION SYSTEM

Instrument control – GPIB – VISA – instrument drivers-serial port communication. Data Acquisition: Review of Transducer and Signal conditioning, DAQ hardware- Analog inputs – Analog outputs- Digital I/O- DAQ assistant and configurations.

UNIT 5 APPLICATIONS OF VIRTUAL INSTRUMENTATION

Signal Processing and Analysis, Image acquisition and processing–Biomedical Startup Kit–Motion control– Control Design and Simulation Tools –Simulation Interface Toolkit –Embedded Module –GSD Applications.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. Jovitha Jerome "Virtual Instrumentation using labview" Prentice Hall of India, NewDelhi, 2010.
- 2. Gary W.Johnson and Richard Jennings, "LabVIEW Graphical Programming", McGraw Hill, 4th Edition, New York, 2011.
- 3. Jeffrey Travis and Jim Kring, "LabVIEW for everyone", 3rd edition, Dorling Kindersley, 2009.

REFERENCES:

- 1. Lisa K. wells & Jeffrey Travis, "Lab view for everyone", Prentice Hall Inc., New Jersey; Firstedition 1997.
- 2. Gupta .S.,Gupta J.P, "PC interfacing for Data Acquisition & Process Control" 2nd edition, Instrument Society of America, 1994.
- 3. Sanjay Gupta, Joseph John"Virtual Instrumentation using LabVIEW", TataMcGraw Hill, 2nd Edition, NewDelhi, 2005.

e-Resources

- 1. http://www.ni.com/academic/students/learn-labview/
- 2. http://www.ni.com/white-paper/3536/en/

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Preamble

Data analytics is very important for processing and storing data securely especially medical data. Understanding of the technique facilitates the purpose of analysis.

HEALTH CARE ANALYTICS

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Demonstrate fundamental knowledge of Big data analytics.
- Explore different types of data from different sources. 2.
- 3. Perform various statistical analysis using R packages for given data set.
- 4. Explain problem solving methods, knowledge representation and inference.
- Apply knowledge of big data analytics on bioinformatics and health care data set. 5.

UNIT 1 **INTRODUCTION**

Data analytics overview, Data life cycle, Traditional Data mining Life cycle, CRISP, Big Data life cycle methodologies, Machine learning implementation, Recommender system, Dashboard, Ad-Hoc analysis. Data Collection, Data Pre-processing, Data Cleaning.

BIG DATA METHODS & ANALYSIS UNIT 2

Introduction to R programming, Data Frames, Atomic vectors, Factors, Data types, Variables, Functions, working with excel files, Data interface. Develop pie chart, 3D pie chart, Histograms, Bar chart, Group bar chart, Stacked Bar chart. 9

UNIT 3 STATISTICAL METHODS IN HEALTHCARE

Regression models, Linear Regression, Multiple regression, Logistic regression, Mean, Median, Mode, Chi-Square test. T-Test.

UNIT 4 **KNOWLEDGE INTERFERENCE**

Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory

UNIT 5 DATA ANALYTICS FOR HEALTH CARE

Data analytics in diagnostics, Health care, preventive medicine, precision medicine, population health, Text mining on complex biomedical literature, medical imaging.

TEXT BOOKS:

- Venkat Ankam, "Big Data analytics", Packt publishing 2016. 1
- Parag Kulkarni, Sarang Joshi," Big Data analytics ", PHI learning, 2016. 2
- 3 Stuart Russel and Peter Norvig "AI - A Modern Approach", 2nd Edition, Pearson Education2007.

REFERENCES:

Wang, Baoying, Big Data Analytics in Bioinformatics and Health 1

e-RESOURCES:

- 1 https://onlinecourses.nptel.ac.in/noc22 hs40/preview
- 2 https://onlinecourses.nptel.ac.in/noc21 cs45/preview

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Lecture: 45, Tutorial: 0, Total: 45

1. Explain the types and applications of pattern recognition with error rate estimation.

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

- 2. Apply the pattern recognition techniques to the clustering analysis with algorithms.
- 3. Explain the fundamentals of Neural Networks and compare with biological Neural Network.
- 4. Discuss the function of neural networks of the Back-propagation, Hopfield, CPN and SOM.
- 5. Perform algorithmic training of various neural networks.

UNIT 1 INTRODUCTION AND SUPERVISED LEARNING

Applications of Pattern recognition, Random variables, Types of Pattern recognition, Statistical Decision making – Bayes" theorem –multiple features-Decision Boundaries - estimation of error rates, Nonparametric Decision making – histograms – kernels -window estimators - nearest neighbor classification - Adaptive Decision Boundaries - adaptive and Minimum Squared error Discriminant functions. 9

UNIT 2 **UNSUPERVISED LEARNING AND CLUSTERING ANALYSIS**

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

UNIT 3 **INTRODUCTION AND SIMPLE NEURAL NET**

Introduction – Artificial Neural Networks - Biological neural network- Comparison- Basic Building blocks- Terminologies, Fundamental Model of Artificial Neural Networks, Perceptron, Adaline and Madaline.

UNIT 4 **BACK PROPAGATION AND ASSOCIATIVE MEMORY**

Back propagation network, generalized delta rule, Associative memory Network, Hopfield Network UNIT 5 **NEURAL NETWORKS BASED ON COMPETITION**

Kohonen Self organizing map, Learning Vector Quantization, Counter Propagation network. **TOTAL : 45 PERIODS**

TEXT BOOKS:

- Earl Gose, Richard Johnsonbaugh and StveJost, "Pattern Recognition and Image analysis", PHILearning 1. Private Limited, New Delhi, 2009.
- S.N. Sivanandam, S.Sumathi and S.N. Deepa, "Introduction to Neural Networks using MATLAB 6.0", 2
- McGraw Hill Education (India) Private Limited, New Delhi, 2006.

REFERENCES:

- Duda R.O. Hart P.G, "Pattern Classification and scene analysis", Wiley Edition 2000. 1.
- 2. Hagan, Demuth and Beale, "Neural network design", Vikas Publishing House Pvt Ltd., New Delhi, 2002.
- Freeman J.A., and Skapura B.M, "Neural Networks, Algorithms, Applications and Programming 3. Techniques", Addison - Wesley, 2003.
- S.N. Sivanandam and S.N. Deepa, "Principles of Soft computing", John Wiley & Sons, Second edition, 2011. 4.

e-RESOURCES:

http://nptel.ac.in/courses/117105101/, "Pattern Recognition and Application", Prof. P. K. Biswas, Indian 1. Institute of Technology, Kharagpur.

recognition and image processing.

3 0 0 3 **Preamble:** The course will introduce the student to the fundamentals of pattern recognition and its application

covers basic neural network architectures and learning algorithms, for applications in pattern

with several supervised and unsupervised algorithms suitable for pattern classification. The course also

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- 2. http://nptel.ac.in/courses/117108048/, "Pattern Recognition", Prof. P. S. Sastry, Indian Institute ofScience, Bangalore.
- 3. http://nptel.ac.in/courses/117105084/, "Neural Networks and Applications", Prof.S. Sengupta, IIT Kharagpur.

21BME27 BRAIN COMPUTER INTERFACE AND APPLICATIONS

LTPC 3003

Preamble:

To impart the knowledge on the signal acquisition and signal processing methods in BCI which translate the information in the control signals into commands that operate a computer or other device

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

- 1. Discuss the basics of brain computer interface and its types depending on data processing modality.
- 2. Recognize the patterns and stimulus related potentials involved in brain activation.
- 3. Identify the feature extraction and feature reduction using Data Processing and Spatial filtering
- 4. Explain the algorithms for translation using neural networks.
- 5. Discuss the significance and role of brain computer interface in the contemporary world.

UNIT 1 INTRODUCTION TO BCI

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI

UNIT 2 BRAIN ACTIVATION

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT 3 FEATURE EXTRACTION METHODS

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence

UNIT 4 FEATURETRANSLATION METHODS

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF,,s, Perceptron,,s, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis

UNIT 5 APPLICATIONS OF BCI

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

TEXT BOOKS:

- 1. Rajesh.P.N.Rao,-Brain Computer Interfacing: Introduction, Cambridge University Press, 1stedition, 2013.
- 2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, —Brain Computer Interfaces: Principles and practicel, Oxford University Press, USA, Edition 1, January 2012.

REFERENCES:

- 1. Ella Hassianien, A & Azar.A.T (Editors), —Brain-Computer Interfaces Current Trends and Applications Springer, 2015.
- 2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
- 3. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch, A survey of signal Processing algorithms in brain-computer interfaces based on electrical brain signals Journal of Neural Engineering.
- 4. ArnonKohen, Biomedical Signal Processing Vol I and II, CRC Press Inc, Boca Rato, Florida.
- 5. Bishop C.M., Neural networks for Pattern Recognition Oxford, Clarendon Press, 1995.

e-RESOURCES:

- 1. <u>https://nptel.ac.in/courses/106103115/</u>," Human Computer Interaction", Prof. Dr. PradeepYammiyavar, Indian Institute of Technology Guwahati
- 2. <u>https://sccn.ucsd.edu/wiki/Introduction_To_Modern_Brain-Computer_Interface_Design</u>,"Introduction To Modern Brain-Computer Interface Design,Christian A. Kothe Swartz ,Center for Computational Neuroscience, University of California San Diego

TOTAL: 45 PERIODS

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Preamble

This course aims at designing Analog and Digital communication systems that are used for the transmission of information. A detailed quantitative framework for analog and digital transmission techniques is addressed.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Evaluate the AM, FM and PM systems with respect to performance and signal to noise ratio.
- 2. Compare the performance of various shift keying techniques used in digital communication systems
- 3. Analyze the characteristics of PAM, PTM and PCM modulation techniques and evaluate natural and flat top sampling techniques in digital pulse modulation
- Compare and contrast of Huffman and Shannon-Fano coding techniques for coding efficiency of lossless 4. data compression
- 5. Summarize the basic physical and technical settings of mobile communication systems and illustrate the orbital parameters of a satellite.

ANALOG COMMUNICATION UNIT 1

Introduction to Communication Systems: Modulation - Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation -Comparison of various Analog Communication System (AM - FM - PM). 9

UNIT 2 **DIGITAL COMMUNICATION**

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

DATA AND PULSE COMMUNICATION UNIT 3

Data Communication: Standards Organizations for Data Communication - Data Communication Circuits- Error Detection and Correction Techniques - Data communication Hardware

Pulse Communication: Pulse Amplitude Modulation (PAM) - Pulse Time Modulation (PTM) - Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM)

UNIT 4 SOURCE AND ERROR CONTROL CODING

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes 9

MULTI-USER RADIO COMMUNICATION UNIT 5

Global System for Mobile Communications (GSM) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off – Satellite Communication: Kepler"s Law – satellite orbit – Geostationary Satellite – Satellite link modes – Bluetooth – Wi Fi.

Lecture: 45, Tutorial: 0, Total: 45

TEXT BOOKS:

- Wayne Tomasi, "Electronic Communication Systems", 5th Edition, Pearson Education, 2008. 1.
- 2. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCES:

- Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004 1.
- 2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
- H.Taub, D L Schilling and G Saha, "Principles of Communication", 3rd Edition, Pearson Education, 2007. 3.

e-Resources:

- 1. Nptel video http://nptel.ac.in/courses/ 117101051 /, "Quantization, PCM and Delta Modulation", Prof. Bikash Kumar Dey, IIT, Bombay.
- Nptel video http://nptel.ac.in/courses/ 117101051 /, "Source Coding (Part 1)", Prof. Bikash Kumar Dey, 2. IIT, Bombay.
- 3. Nptel video http://nptel.ac.in/courses/ 117101051 /, "Introduction to Digital Communication)", Prof. Bikash Kumar Dey, III, Bombay.

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VCET, B.E-BME, R2018 Ver-4, Curriculum and Syllabus

COMPUTER NETWORKS

21BME32 Preamble:

The course aims to provide an understanding of computer networks architecture, various technologies available to build a network and protocols in use at different levels of network layers stack. An overview of global Internet, Internet applications and types of protocols used for mail transfer is also provided.

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

- 1. Interpret the importance of layering, addressing and annotate the protocol stack of OSI and TCP/IP model.
- 2. Annotate MAC protocols (Ethernet, Token Ring and Wi-Fi) supported by Data Link layer to ensure hop-to-hop reliable communication.
- 3. Use IP addressing and routing protocols to find shortest route to achieve reliable network-layer data transmission.
- 4. Classify the transport layer protocols and explain the congestion control or congestion avoidance techniques to ensure quality of service.
- 5. Analyze the functions and services provided by the application layer protocols (HTTP, SMTP and DNS).

UNIT 1 DATA COMMUNICATIONS

Data Communication- Networks-The OSI Model- Layers in the OSI Model - TCP/IP Protocol Suite - Addressing - Transmission Media

UNIT 2 DATA LINK LAYER

Framing – Error Detection and Correction– IEEE Standards(802.3,802.5,802.11)– MAC protocols and types

UNIT 3 NETWORK LAYER

Internetworking: Switching and Bridging – Basic Internetworking -IPv4 - IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) — Interdomain Routing (BGP).

UNIT 4 TRANSPORT LAYER

Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service: Integrated Services – Differentiated Services.

UNIT 5 APPLICATION LAYER

Domain Name System - File Transfer – Web Services and SNMP - HTTP - Electronic Mail (SMTP, POP3, IMAP, MIME).

TOTAL : 45 PERIODS

- 1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.
- 2. Behrouz A. Forouzan, "Data Communications and Networking", Fourth Edition, Tata McGraw -Hill, Reprint 2012.

REFERENCES:

TEXT BOOKS:

- 1. William Stallings, "Data Communication and Networks", Pearson Education, Tenth edition, 2014.
- 2. James .F. Kurouse & W. Rouse, "Computer Networking: A Topdown Approach Featuring", Sixth edition, Pearson Education, 2013.
- 3. William Stallings, "Data Communication and Networks", Pearson Education, Tenth edition, 2014.

e-RESOURCES:

- 1. http://www.nptel.ac.in/downloads/106105080, Computer Networks, Prof.Sujoy Ghosh, IIT Kharagpur.
- 2. https://www.elsevier.com/journals/subjects/computer-science.

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Preamble

Embedded systems and IOT devices are essential to understand the fundamentals to gain knowledge on telemedicine. IoT design considerations, constraints and interfacing between the physical world and the device will make design trade-offs between hardware and software.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Explain fundamental embedded systems design paradigms, architectures, possibilities, and
- ¹ challenges, both with respect to software and hardware.
- 2. Describe the hardware architecture and features of embedded microcontrollers and peripherals.
- 3. Explain software design tools and embedded system design programming phases.
- 4. Describe IoT Architectures and Build simple IoT Systems using embedded target boards.
- 5. Exhibit understanding of IoMT infrastructure for healthcare applications.

UNIT 1 INTRODUCTION TO EMBEDDED SYSTEM DESIGN

Introduction to embedded processors- Application Areas- Categories of embedded processors- Challenges in Embedded System Design, Design Process- Requirements- Specifications- Hardware architecture-Software architecture-Introduction to Harvard & Von Neuman architectures- CISC & RISC Architectures. CPU Bus- Bus Protocols- Bus Organisation, Memory Devices, and their Characteristics- RAM, EEPROM-Flash Memory- DRAM. BIOS, POST, Device Drivers.

UNIT 2 PERIPHERAL INTERFACING

I/O Devices-Timers and Counters- Watchdog Timers, Interrupt Controllers- A/D and D/A, Interfacing-Memory interfacing with a case study- I/O Device Interfacing with case Study- Programmed IO-Memory Mapped IO, Interfacing Protocols-SPI, I2C, USB, CAN, Ethernet/WiFi, Bluetooth.

UNIT 3 EMBEDDED SYSTEM SOFTWARE DESIGN

Application Software, System Software, Design techniques – State diagrams, sequence diagrams, flowcharts, etc., Model-based system engineering (MBSE), Use of High-Level Languages- embedded C / C++ Programming, Integrated Development Environment tools- Editor- Compiler- Linker- Automatic Code Generators- Debugger- Board Support Library- Chip Support Library, Analysis and Optimization-Execution Time- Energy & Power.

UNIT 4 DESIGN AND DEVELOPMENT OF IOT

Definition and characteristics of IoT, Technical Building blocks of IoT, Communication Technologies, Physical design of IoT - system building blocks - sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino), Benefits and impact of IoMT. Cybersecurity – vulnerability, penetration & encryption technologies.

UNIT 5 INTERNET OF MEDICAL THINGS

Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An IoT Model for Neuro sensors, AdaBoost with feature selection using IoT for somatic mutations evaluation in Cancer, A Fuzzy- Based expert System to diagnose Alzheimer's Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application Development in Mobile and Cloud Environments.

Lecture : 45, Tutorial : 0, Total : 45

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TEXT BOOKS:

- 1. Embedded Systems A Contemporary Design Tool, James K Peckol, , John Weily, 2008, ISBN: 0-444-51616-6.
 - David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "loT
- 2. Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
 - Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, "Internet of Things and
- 3. Personalized Healthcare Systems", Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019.

REFERENCES:

- 1. Introduction to Embedded Systems, Shibu K V, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 00706787903.
- 2. Embedded Software Primer, David E.Simon, ,Addison Wesley, ISBN-13: 978-0201615692.
- 3. The Intel Microprocessors, Architecture, Programming and Interfacing" Barry B.Brey, 6th Edition, Pearson Education.

e-Resources:

- 1. IoT Embedded Devices and System Javatpoint.
- 2. Introduction to the Internet of Things and Embedded Systems Course (UC Irvine) | Coursera.

Preamble:

This course provides information about characteristics of wireless sensors and their basic operations in various applications of emerging and exciting domain of wireless network.

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

- 1. Summarize the utility and application of Wireless sensor networks to overcome the challenges faced by Physical Environment.
- 2. Identify the quality of hardware and software components and topologies used in standalone and centrally coordinated wireless network.
- 3. Compare and contrast various routing protocols to find shortest path to reach the destination node with minimum energy consumption.
- 4. Illustrate clustering methods to obtain maximum energy conservation from each node of the network.
- 5. Compare and contrast ns-2 and TOSSIM simulators to provide substantial support for simulation of different routing protocols over wired and wireless networks.

UNIT 1 OVERVIEW OF WIRELESS SENSOR NETWORKS

The vision of Ambient Intelligence – Application Examples – Types of Applications – Challenges for Wireless Sensor Networks – Comparison of Mobile ad hoc networks and wireless sensor networks – Enabling Technologies for Wireless Sensor Networks

UNIT 2 ARCHITECTURES

Single-Node Architecture – Hardware Components – Energy Consumption of Sensor Nodes – Operating Systems and Execution Environments – Network Architecture – Sensor Network Scenarios – Optimization Goals and Figures of Merit – Gateway Concepts

UNIT 3 NETWORKING SENSORS

Physical Layer and Transceiver Design Considerations – MAC Protocols for Wireless Sensor Networks – Low Duty Cycle Protocols and Wakeup Concepts – S-MAC – The Mediation Device Protocol – Wakeup Radio Concepts – Address and Name Management – Assignment of MAC Addresses – Routing Protocols – Energy – Efficient Routing, Geographic Routing.

UNIT 4 INFRASTRUCTURE ESTABLISHMENT ,SENSOR TASKING AND CONTROL

Topology Control – Clustering – Time Synchronization – Localization and Localization services. Task-Driven sensing-Roles of sensor nodes and utilities-Information based sensor tasking –Joint routing and Information Aggregation.

UNIT 5 SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes – Programming Challenges – Node-level software platforms – Node-level Simulators – State-centric programming.

TEXT BOOKS:

- Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005
- 2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2007.

REFERENCES:

- 1. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols and Applications", John Wiley, 2007.
- 2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

e-RESOURCES :

1. https://www.youtube.com/user/cecedusat, "Wireless Sensor Networks", Dr. Adwitiya Sinha, AP, Eminent University, Delhi.

TOTAL: 45 PERIODS

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2. NPTEL Video :https://www.youtube.com/watch?v=GUSrkWJ_Z2g "Introduction: Wireless Sensor Networks- Part- I " Prof.SudipMisra, IIT,Kharagpur.

21BME35

Preamble:

The course describes the hardware requirements, communication and security aspects in Body Area Networks. It enumerates the coexistence issues with Body Area Networks and also showcases the application areas of Body Area Networks.

BODY AREA NETWORKS

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

- Comprehend the principal requirements of Body Area Networks. 1
- 2 Specify the hardware requirements of BAN for appropriate application in medicine.
- 3 Explain the efficiency of communication and the security parameters.
- 4 Enumerate the coexistence issues with Body Area Networks
- Extend the concepts of BAN for medical applications. 5

INTRODUCTION UNIT 1

ntroduction - BAN and Healthcare, BAN Architecture - BAN principal requirements: Safety, Security, Sustainability und reliability.

HARDWARE FOR BAN UNIT 2

Sensor Nodes and Hardware Designs- Wireless transceivers and microcontrollers - Antenna-Sensor Interface- Power sources- Existing sensor boards- Design of Implanted Sensors Nodes for WBAN Processor.

WIRELESS COMMUNICATION AND NETWORK UNIT 3

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand Alone 3AN, Wireless personal Area Network Technologies-IEEE 802.15.1, IEEE P802.15.3, IEEE 802.15.4, Zigbee.

UNIT 4 **COEXISTENCE ISSUES WITH BAN**

nterferences – 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.

UNIT 5 **APPLICATIONS OF BAN**

Monitoring patients with chronic disease, Patient monitoring in clinical setup, Multiparameter patient monitoring systems, Cardiac arrhythmias monitoring, Multichannel Neural recording, Gait analysis, Parkinson's disease assessment systems, Sports Training Application.

TEXT BOOKS:

- Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, "Body Area Networks Safety, 1 Security, and Sustainability", Cambridge University Press, 2013.
- Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", 2 Pan Stanford Publishing Pte. Ltd., Singapore, 2012.

REFERENCES:

- Zhang, Yuan-Ting, "Wearable Medical Sensors and Systems", Springer, 2013. 1
- 2 Juang-Zhong Yang(Ed.), "Body Sensor Networks", Springer, 2006.
- 3 Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011

e-RESOURCES:

- 1ttps://www.mdpi.com/2224-2708/11/4/67 1
- 2. https://www.hindawi.com/journals/isrn/2011/692592/

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TOTAL: 45 PERIODS

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MEDICAL INFORMATICS

Preamble:

Medical informatics is the study of applications of information technology in health care management. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

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

- 1. Explain the structure and functional capabilities of Hospital Information System.
- 2. Describe the need of computers in medical imaging and automated clinical laboratory.
- 3. Articulate the functioning of information storage and retrieval in computerized patient record system.
- 4. Apply the suitable decision support system for automated clinical diagnosis.
- 5. Discuss the application of virtual reality and telehealth technology in medical industry.

UNIT 1 INTRODUCTION TO MEDICAL INFORMATICS

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics

UNIT 2 COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING

Automated clinicallaboratories-Automated methods in hematology, cytology and histology, IntelligentLaboratory InformationSystem - Computerized ECG, EEG and EMG, Computer assisted medicalimaging-nuclear medicine,ultrasoundimaging,computedXtomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT 3 COMPUTERISED PATIENT RECORD

Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT 4 COMPUTER ASSISTED MEDICAL DECISION-MAKING

NeurocomputersandArtificialNeuralNetworksapplication,Expertsystem-General model of CMD, Computer–assisted decision support system-production rule system cognitivemodel,semanticnetworks,decisionsanalysisinclinicalmedicine-computersin the care of critically ill patients, Computer aids for the handicapped.

UNIT 5 RECENT TRENDS IN MEDICAL INFORMATICS

Virtualreality applicationsinmedicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patiented ucation and health- Medical education and health care information, computer assisted instruction in medicine.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Mohan Bansal, "Medical informatics", Tata McGraw Hill Publishing Ltd, 2003.

2. R.D.Lele, "Computers in medicine progress in medical informatics", Tata Mcgraw Hill,2005 **REFERENCES:**

REFERENCES:

1. Kathryn J. Hannah, Marion J Ball, "Health Informatics", 3rd Edition, Springer, 2006. e-RESOURCES:

1. Coursera, https://www.coursera.org/learn/health-informatics-professional, "Interprofessional Healthcare Informatics", Prof. Karen Monsen, University of Minnesota.

Coursera, https://www.coursera.org/learn/ehealth?, "eHealth: More than just an electronic record", Prof. Tim Shaw, The University of Sydney.

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21BME37

Preamble:

This course helps the students to learn about the E Healthcare with their standards. Also this course gives the detail information about the mobile health, web applications and ethical and legal aspects of telemedicine.

TELEHEALTH TECHNOLOGY

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

- 1. Explain the basic principle of healthcare in telemedicine
- 2. Discuss the various information transmission technologies in telehealth.
- 3. Explain the role of telecommunication in telehealth technology.
- 4. Summarize the ethical and legal issues involved in telemedicine.
- 5. Discuss the various applications of telemedicine in medical field.

UNIT 1 HISTORY AND FUNDAMENTALS OF TELEMEDICINE

Definitions of telemedicine, telehealth and telecare- drivers of telemedicine and telecare - telemedicine in developed and underdeveloped countries- the future for telemedicine. Types of telemedicine- teleconsultation, tele-education, telemonitoring, telesurgery- benefits and limitations of telemedicine.

UNIT 2 TECHNOLOGY OF TELMEDICINE SYSTEMS

Information types and transmission- text and data, audio, still (single) images, video and frame rate and bandwidth - telecommunication standards – teleconsultation system - the video conferencing system, multipoint systems, the image display system and telemonitoring devices. Telecommunication options components- service considerations, ISDN, satellite, dedicated wide area connections - Integration and operational issues.

UNIT 3 MOBILE HEALTH AND WEB APPLICATIONS

Mobile Health Today- mHealth Based on Text Messaging, mHealth and Smart phones and History of Smartphone Based mHealth Devices - mHealth and Other Technologies- Emerging Trends and Areas of Interest in mHealth- Health Informatics Standards- Wireless Technologies Used in mHealth- Web Applications - mHealth Challenges and Ethics.

UNIT 4 ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE

Ethical and legal aspects of Telemedicine (Case study) - Confidentiality, Social and legal issues (Case Study), Safety and regulatory issues (Case Study), the patient-doctor relationship, access to medical records, consent treatment - data protection & security.

UNIT 5 APPLICATION OF TELEHEALTH TECHNOLOGY

Teleradiology, telepathology, telecardiology, tele oncology, tele dermatology, telesurgery, e Health care.

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1. Norris A.C, "Essentials of Telemedicine and Telecare", John Wiley & Sons, 2002.
- 2. HalitEren, John G. Webster, "telehealth and mobile health", CRC press, 2016.

REFERENCES:

- 1. Bernard Fong, A.C.M. Fong, C.K. Li, "Telemedicine Technologies Information Technologies in Medicine and Telehealth", John Wiley & Sons, 2011.
- 2. Adam Darkins, Margaret Cary, "Telemedicine and Telehealth Principles, Policies, Performance and Pitfalls", Springer, 2000.
- 3. Olga Ferrer-Roca, M.SosaLudicissa, "Handbook of Telemedicine", IOS press 2002.

e-RESOURCES:

- 1. <u>https://www.coursera.org/lecture/healthcare-it/module-4-telehealth-IKo2k</u>, "Healthcare IT: challenges and opportunities", Bruce J Darrow, MD, PhD, ASSOCIATE PROFESSOR of Cardiology & Population Health Science, Icahn school of medicine.
- 2. <u>https://www.classcentral.com/course/newwayhealthcare-657</u>,"Interprofessional Healthcare Informatics", Karen Monsen, University of Minnesota Courses.

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Preamble:

This course applies and builds on the concepts of statics, dynamics for human activities, and mechanics of materials and tissues. It provides an overview of structure and function of the mechanical aspects of biological systems from whole organisms to organs, cells and cell organelles using the methods of mechanics.

BIOMECHANICS

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

- 1. Illustrate the ways in which the kinetic and kinematics quantities can be applied to study human movement.
- 2. Describe tissue injury in bone and cartilage using principle of mechanics.
- 3. Identify the viscoelastic properties of blood and analyze Newtonian and non-Newtonian fluids.
- 4. Derive the criteria for orthopedic implant design using complex mechanics of skeletal muscles.
- 5. Analyze the stresses and strains in shoulder, spine and hip using different loading conditions.

UNIT 1 MECHANICS OF HUMAN MOTION

Principles of Mechanics-Newton''s law- mechanical behavior of bodies in contact, work, power and energy relationship – Angular Kinetics of human movement – Resistant to angular acceleration- Angular momentum- Linear Kinematics of human movement-Linear Kinematics - Projectile motion- Factors influencing Projectile trajectory -Angular kinematics of human movement-measuring angles, angular kinematic relationships –

relationships between linear and angular motion.

UNIT 2 BIOFLUID MECHANICS

Stress, strain- strain rate – Hooke"s-law – Viscosity – Newtonian fluid – Non-Newtonian fluid – rheological properties of blood, laminar flow - turbulent flow – structure and composition of blood vessels-Mechanical properties of blood vessels-Medical applications of blood rheology

UNIT 3 BONE AND CARTILAGE

Bone structure & composition- Types of bone - blood circulation in bone - Bone growth and development viscoelastic properties of bone - Maxwell & Voight models - viscoelastic properties of articular cartilage - Bone response to stress - Elasticity and strength of bone -Common bone injuries- Osteoporosis - causes, diagnosis, and treatment.

UNIT 4 MECHANICS OF SKELETAL MUSCLE

Structure of skeletal muscle – muscle fibers, motor units – Structure of skeletal muscle-fiber types, fiber architecture – Sliding element theory of skeletal muscle.- Skeletal muscle function – Contraction of skeletal muscle and Hill"s three element model – Factors affecting muscular force generation – Muscular strength, power and endurance – Muscle injuries

UNIT 5 MECHANICS OF SHOULDER, SPINE AND HIP

Structure of the shoulder – Movements of shoulder complex – Loads on the shoulder – Structure of the spine – Movements of the spine – Muscles and loads on the spine – Structure and movements of the hip – Loads on the hip. Common injuries of shoulder, spine and hip

TEXT BOOKS:

- 1. Fung Y C, Biomechanics: "Mechanical Properties of Living Tissues", Springer, 2nd edition, 2008.
- 2. Susan J Hall, "Basic biomechanics", Tata Mcgraw hill, 4th edition, 2003.

REFERENCES:

- 1. Duane Knudson, "Fundamentals of Biomechanics", Springer Science plus Business Media, 2nd Edition, 2007.
- 2. Ellen Kreighbaum, Katharine M.Barthels, "Biomechanics, A Qualitative approach for studying humanmovement" Allyn and Bacon, Fourth Edition, 1996.

e-RESOURCES:

- 1. http://nptel.ac.in/courses/112105171/1,"Fluid Mechanics"Prof. S.K. Som, Department of Mechanical Engineering, Indian Institute of Technology, Kharagpur.
- 2. http://nptel.kmeacollege.ac.in/syllabus/112106059/

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TOTAL: 45 PERIODS

BIOFLUIDS AND DYNAMICS

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Preamble:

With rapid advancements in the biomedical science and engineering, there is a need for engineers with knowledge in multiple disciplines. This course aim to develop an understanding of the role fluid dynamics plays in the human circulatory system. The course is an introduction to the physiologically relevant fluid flow phenomena and underlying physical mechanisms from the viewpoint of an engineer.

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

- 1. Analyze the problems related to fluid mechanics in human body system and solve by engineering concepts.
- 2. Discuss the properties of blood and its static, dynamics behavior.
- 3. Analyze the structure of blood vessels, tissue valves and its correlation with mathematical modeling.
- 4. Describe the flow of blood and identify the pressure measurement in various blood vessels, valves.
- 5. Interpret the various modeling systems and its applications in biological systems.

UNIT 1 REVIEW OF BASIC FLUID MECHANICS CONCEPTS

A brief history of biomedical fluid mechanics- fluid characteristics and viscosity, displacement and velocity, shear stress and viscosity, Fundamental method for measuring viscosity, Introduction to pipe flow, - Reynolds number, poiseuille's law, Flow rate, Bernoulli Equation, conservation of mass, Fluid statics,

UNIT 2 HEMATOLOGY AND BLOOD RHEOLOGY

Element of blood, Blood characteristic- Types of fluids, Viscosity of blood, Fahreus – lindqvist effect, Einstein"s equation, Viscosity measurement – Rotating cylinder viscometer, Measuring viscosity using poiseuille"s law, Viscosity measurement by a cone and plate viscometer, Erythrocytes – Hemoglobin, clinical features, - sickle cell anemia, Erythrocyte indices, Abnormalities of blood, Clinical feature- thalassemia, Leukocytes, Thrombocytes, Blood Types, Plasma-Plasma viscosity, Electrolyte composition of plasma, Blood pH,

UNIT 3 ANATOMY AND PHYSIOLOGY OF BLOOD VESSELS AND HEART VALVES

General structure of Arteries, Types of Arteries, Mechanics of arterial walls, Compliance, pulse wave velocity – Moens- Korteweg Equation, Pressure – strain modulus, Vascular pathologies- Atherosclerosis, stenosis, Aneurysm, clinical feature – endo vascular aneurysm repair, Thrombosis, Stents, Coronry Artery Bypass Grafting.

Mechanics of heart valves, Aortic and pulmonic valves, Clinical feature, percutaneous aortic valve implantation, Mitral and Tricuspid valves, Pressure Gradients across a Stenotic Heart valve – The Gorlin equation, Energy loss across a stenotic valve, – Prosthetic Tissue Valves.

UNIT 4 BLOOD FLOW AND PRESSURE MEASUREMENT

Pulsatile flow in large arteries, fluid kinematics, Continuity, complex numbers, Fourier series representation, navier – stokes Equations, Pulsatile flow in rigid tubes, womersley solution, fry solution, instability in pulsatile flow. Pressure measurement- Indirect pressure measurement, indirect pressure gradient measurements- Doppler ultrasound- indicator dilution method.

UNIT 5 MODELING

Theory of models- Dimensional analysis and the Buckingham Pi theorem- Synthesizing Pi terms- Geometric similarity- Dynamic and kinematic similarity- Common dimensionless parameters in fluid mechanics -Lumped parameter mathematical models, Electrical analog model of flow in a tube- Nodes and the equations at each nodes-Terminal Load-Modeling of flow through the mitral valve-model description – Active ventricular relaxation.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Lee waite, Jerry Fine, "Applied BiofluidMechaics", The McGraw-Hill Companies, 2007.

REFERENCE BOOKS:

- 1. Ali ostadar" Biofluid Mechanics: Principles and applications" Academic press, 2016.
- 2. Krishnan B. Chandran , Stanley, E.Rittgers and Ajit P. Yoganathan , Biofluid mechanics: The human circulation , 2nd Edition , CRC PRESS , 2012.
- 3. Jagan N Mazumdar, "Biofluid Mechanics", World scientific publishing, 2004.

e- **RESOURCES**:

- 1. https://www.youtube.com/watch?v=AdhWBb7j55c, "Introduction to fluid mechanics"Prof.Dr.SubashisaDutta.
- 2. <u>https://www.youtube.com/watch?v=JDT0gvQAfds&list=PLbRMhDVUMngdKusGmGPHrUFtD_iOK6t_i</u>"

REHABILITATION ENGINEERING

LTPC 3003

Preamble:

Rehabilitation science and engineering to emphasize the importance of both science and engineering in advancing rehabilitation efforts and addressing the needs of people with disabling conditions. It provides the standard methods to regain functions lost due to congenital disorders, disease and injuries like limb loss to restore the function.

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

- Discuss the insights of rehabilitation and different exercises for the betterment of healthcare. 1.
- Interpret the different the visual aids for the augmentation of blind people. 2.
- Describe the sensory and motor functions of hand and the artificial devices used for improvement of lost 3. function.
- Analyze the design, power and fabrication of wheel chair models. 4.
- 5. Illustrate the principles of computer technologies and its application in rehabilitation engineering.

INTRODUCTION UNIT 1

Rehabilitation concepts- impairment, disability, handicap, Epidemiology of rehabilitation, Preventive rehabilitation, Diagnosis of Disability, Socio- vocational rehabilitation, rehabilitation team – medical team, paramedical team, therapeutic exercise – coordination exercises, balance training, gait training, relaxation exercises, strengthening exercises, mobilization exercises, endurance exercises, postural correction, ergonomic exercises, hydrotherapy, suspension therapy. 9

UNIT 2 SENSORY REHABILITATION

Visual system, visual augmentation, tactual vision substitution, auditory vision substitution, auditory system auditory augmentation, visual auditory substitution, tactual auditory substitution, tactual augmentation, tactual substitution, light probes, obstacle sensors, Electronics travel appliances, path sounder, laser cane, ultrasonic torch and guide.

UNIT 3 **MOTOR REHABILITATION**

Orthopedics- prosthetics and orthotics in rehabilitation – fundamentals, applications and computer aided engineering in customized component design, FO, AFO, KAFO, HKAFO, intelligent prosthetic knee, hierarchically controlled prosthetic hand, self-aligning knee joint. Externally powered and controlled orthotics, prosthetics - FES systems. Restoration of hand functions, restoration of standing and walking, hybrid assistive systems. Active above knee prostheses, myoelectric hand and arm prosthesis.

WHEELED MOBILITY AIDS UNIT 4

Categories of wheel chairs, wheel chair structure and component design – materials, frame design, wheels and casters. Ergonomics- wheel chair propulsion- kinetics, kinematics, net joined forces and movements, power wheel chair electrical systems- user interface, integrated control, power systems. Electromagnetic compatibility, Personal transportation-vehicle selection.lift mechanisms, wheel chair restraint mechanisms, hands controls.

UNIT 5 **COMPUTER ACCESS AND APPLICATIONS OF REHABILITATION**

Computer access- user interface, outputs, acceleration techniques, cost effectiveness- intervention- environmental next generation information systems. Rehabilitation applications- conceptual frame work- provision processeducation and quality assurance- specific impairment.

TEXT BOOKS:

- Dr. S.Sunder, Textbook of Rehabilitation, 3rd Edition, Jaypee Medical Publications, New Delhi, 2010. 1.
- Joseph D.Bronzino, "The Biomedical Engineering Handbook" Third Edition: Three volume set, CRC Press, 2006. 2.

REFERENCE BOOKS:

- 1. Horia Nicolai .L, Teodorescu, Lakhmi .c .jain "Intelligent systems and technologies in rehabilitation engineering "1stEdition, CRC press, 2013.
- Dario farina, winne Jensen&metinakay "Introduction to neural engineering for motor rehabilitation" Wiley, IEEE, 2013. 2.
- 3. Rory A Cooper, An introduction to Rehabilitation Engineering, Taylor & Francis, CRC Press, 2006.
- Randall L.Braddom, Hand book of physical medicine and rehabilitation, W.B. Saunders Publications, 2004. 4.

e- RESOURCES:

- 1. https://www.youtube.com/watch?v=qw m-gteuSY"Design considerations: prosthesis and orthosis"Prof. SujathaSrinivasan, Department of mechanical engineering. IIT Madras.
- 2. <u>https://www.youtube.com/watch?v=QMV 4fzJCo</u> HughHerr,MIT MediaLab. Designing intelligent ort hotics and prosthetics.

TOTAL: 45 PERIODS

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PHYSIOLOGICAL MODELING

Preamble:

Physiological systems modeling, simulation and control is a research area integrating science and engineering and contributes to a continuous refinement of knowledge on how the body works. This course provides the concepts on developing of differential equations to describe the dynamic models, simulate and visualize the dynamic responses of physiological models using software.

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

- 1. Explain the application of Physiological models.
- 2. Develop the lung model using transfer function with impedance concept
- 3. Discuss the transient response and frequency response of physiological systems.
- 4. Develop differential equations to describe the dynamic models, simulate and visualize the dynamic responses of physiological models.
- 5. Implement physiological models using MATLAB software to get dynamic responses of feedback systems.

UNIT Î SYSTEM CONCEPT

Review of physiological system modeling - system properties - different configurations of tracheal network, static and dynamic resistance, Thermal resistance in human systems, System with volume storage capacity and its electrical analog, Simplified model of respiratory system, Simulation of aortic segments, Comparison of muscle model isotonic response, Step response of resistant / compliant systems –Dye dilution study of circulation, pulse response of first order system.

UNIT 2 TRANSFER FUNCTION

System as an operator and use of Transfer function, Bio Engineering of coupled systems, Examples of transformed signals and circuits for transfer function with impedance concept - Development of lung model, Impedance of a two stage ladder network, Measurement of airway resistance.

UNIT 3 PERIODIC SIGNALS

Sinusoidal Functions, Analysis of Instrumentation to measure air flow system, second order system – representation of a respiratory system, Evaluation of Transfer function from frequency response for muscle response modes, Relationship between Phase lag and Time Delay-closed loop aspects of papillary control system, Transient Response of an Undamped Second order system, General Description of Natural Frequency Damping, Physical Significance of under damped responses of post systolic operations in aortic arch.

UNIT 4 TRANSIENT OSCILLATIONS AND RESONANCE

Transient response of underdamped second order system and its physical significance-Underdamped response of physiological system-Signal consonance of underdamped second order response-Resonance.

UNIT 5 PHYSIOLOGICAL FEEDBACK SYSTEMS

Characterization of Physiological Feedback systems- Hypophysis adrenal systems, pupillary hippus, Uses and Testing of System Stability.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Willian B. Blesser, "A System Approach to Biomedicine", McGraw Hill Book Co., New York, 1969. **REFERENCES:**

- 1. MichealC.K.Khoo,"Physiological Control System" Analysis, Simulation and Estimation".-Prentice Hall of India, New Delhi, 2001.
- 2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", secondedition, Academic Press, 2005.

e-RESOURCES:

- https://www.edx.org/course/system-dynamics-health-sciences-witsx-hsd101x#!, "System Dynamics for Health Sciences", David Rubin Adjunct Professor, Biomedical Engineering University of the Witwatersrand.
- 2. http://serious-science.org/mathematical-modelling-of-physiological-systems-820, "Mathematical Modelling of Physiological Systems", Thomas Heldt, Asst. Prof. of Electrical and Biomedical Engineering, EECS.

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21BME45

Preamble:

This course aims to introduce the basics of Robotics, Kinematics, Inverse Kinematics to explore various kinematic motion planning solutions for different Robotic configurations.

ROBOTICS IN MEDICINE

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

- 1. Understand the basics of robotic systems.
- 2. Design basic Robotics system and formulate Kinematics.
- 3. Construct Inverse Kinematic motion planning solutions for various Robotic configurations.
- 4. Design Robotic systems for Medical application.
- 5. Explore various applications of Robots in Medicine.

UNIT 1 INTRODUCTION

Introduction Automation and Robots, Classification, Application, Specification, Notations, Direct Kinematics Dot and cross products, Coordinate frames, Rotations, Homogeneous coordinates Link coordination arm equation – Five-axis robot, Four-axis robot, Six-axis robot

UNIT 2 KINEMATICS

Inverse Kinematics – General properties of solutions tool configuration, Five axis robots, Three- Four axis, Six axis Robot, Workspace analysis and trajectory planning work envelope and examples, work space fixtures, Pick and place operations, Continuous path motion, Interpolated motion, Straight-line motion.

UNIT 3 ROBOT VISION

Robot Vision Image representation, Template matching, Polyhedral objects, Shane analysis, Segmentation – Thresholding, region labeling, Shrink operators, Swell operators, Euler numbers, Perspective transformation, Structured illumination, Camera calibration.

UNIT 4 PLANNING

Task Planning Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine-motion planning, Simulation of planar motion, Source and Goal scenes, Task Planner simulation.

UNIT 5 APPLICATIONS

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery.

TEXT BOOKS:

- 1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003.
- 2. J.J.Craig, "Introduction to Robotics", Pearson Education,7th Edition, 2016.

REFERENCES:

- 1. Staugaard, Andrew C, "Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning", Prentice Hall Of India, 2006.
- 2. Grover, Wiess, Nagel, Oderey, "Industrial Robotics: Technology, Programming and Applications", McGraw Hill, 2012.
- 3. Wolfram Stadler, "Analytical Robotics and Mechatronics", McGraw Hill, 1995.
- 4. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001.
- 5. K. S. Fu, R. C. Gonzales and C. S. G. Lee, "Robotics", McGraw Hill, 2008.

TOTAL: 45 PERIODS

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21BME46 Pre-requisites: Biochemistry, Biomaterials Preamble:

Biomimetics is the field of science and engineering that seeks to understand and to use nature as a model for copying, adapting, and inspiring concepts and designs It is a method of learning new principles and processes based on systematic study, observation and experimentation with live animals and organisms. Course Description: This course will introduce the interdisciplinary field of biomimicry. The students will learn essential concepts of biomimicry using multiple perspectives including biology, design, business and engineering. Biomimicry is the process of learning about and from nature in order to transfer that knowledge and propose innovative solutions to human-related problems. That same process also helps advance knowledge creation in Biomedical Engineering.

BIOLOGICALLY INSPIRED TECHNOLOGIES AND MECHANISMS UNIT 1

Artificial Intelligence, Artificial and Biomimetic Materials, Vision and Colors, Artificial Muscles, Inchworm Motors. Robotics as a Beneficiary of Biomimetic Technologies, Nature as a Source of Innovation for Operation in Water, Birds and Insects as the Source of Inspiring Flight: Birdman Flying Sport, A Bird like Flying Device with Flapping Wings, Morphing Aircraft Wings, Anti-G Fluid-Pressurized Pilot Suit Inspired by the Dragonfly.

9 UNIT 2 **EVOLUTIONARY ROBOTICS AND OPEN-ENDED DESIGN AUTOMATION** Model of Evolutionary Adaptation, Machine Bodies and Brains: Evolving Controllers, Evolving Bodies and Brains. Morphology Representations: Tree Representations. Developmental Representations, Regulatory Network Representations. Evolving Machines in Physical Reality: Evolving Controllers for Physical Morphologies, Making Morphological Changes in Hardware. The Economy of Design Automation

UNIT 3 GENETIC ALGORITHMS: MIMICKING EVOLUTION AND NATURAL SELECTION 9 IN OPTIMIZATION MODELS

Common Metaheuristic Methods, The Framework of Genetic Algorithms, Modifications of the Genetic Algorithm Framework: Parallel Genetic Algorithms, Compounded Genetic Algorithms, Hybrid Genetic Algorithms, Mutations, Invasions, Gender, Distance-Based Parent Selection, Removal of Population Members, The Genetic Algorithm Process, Steepest Descent Algorithm, Mutation, Calculating Diversity, Application: Balancing a Turbine Engine, Turbine Balancing

BIO-NANOROBOTICS: A FIELD INSPIRED BY NATURE UNIT 4 The ATPase Motor, Kinesin and Myosin, The Flagella Motors, DNA-Based Biomolecular Machine: Molecular Nanomachines, Joints, and Actuators, nanosensors, Design and Control Philosophies for Nanorobotic Systems, Bio-Nano Components, Assembled Bio-Nanorobots, Distributive Intelligence, Programming and Control, Automatic Fabrication and Information Processing Machines, Design Architecture for the Bio-Nanorobotic Systems, Self-Replication — Mimetics: A Novel Property of Living Systems

DEFENSE AND ATTACK STRATEGIES AND MECHANISMS IN BIOLOGY 9 UNIT 5 Acoustics: Blast Wave Projector, Infrasound, Squawk Box, Anti lethal devices, Body Armor, Passive Camouflage, Warning Coloration, Active Camouflage, Translucent Camouflage, Reflecting Camouflage, Motion Camouflage, False Target Generation, Barriers, Slick Coating, Sticky Coating, Sticky, Rope, Smoke, Stakes Bio-technicals Hypodermic Syringe or Dart Neuro-Implant, Pheromones, Elastic Mechanisms, Electrical Stun Gun, Entanglers: Bola, Cloggers, Projectile, Water Stream, Riot Control Agent, Chemical Mace, Operational, Long-Term Disablement Passive Deterrents, Physiological: Neurochemical Diversion . Surveillance Electrosensing

TOTAL: 45 PERIODS

TEXT BOOKS: Yoseph Bar-Cohen, Biomimetics- Biologically Inspired Technologies, CRC Press, 2005.

Yoseph Bar-Cohen, Biomimetics Nature - Based Innovation, , CRC Press, 2012 2

REFERENCES:

- Vogel, Steven. Cats' Paws and Catapults: Mechanical Worlds of Nature and People. W. W. Norton & Company, 2000. ISBN: 9780393319903. 1
- 2 Biomimetics: Nature-Inspired Design and Innovation, Sandy B. Primrose, John Wiley & Sons Ltd, 2020

e-RESOURCES:

- NPTEL., https://archive.nptel.ac.in/courses/127/106/127106231/ Introduction to Biomimicry, Dr.Shiva 1 Subramanium, IIT Chennai.
- 2 Biomimetics is a peer-reviewed, open access journal of biomimicry and bionics, published quarterly online by
- MDPI. https://www.mdpi.com/journal/biomimetics .

FORENSIC SCIENCE IN HEALTHCARE

22BME47 **Preamble:**

This course provides the history of the forensic sciences and its place in popular culture and the roles of different types of professionals involved in evaluating a crime scene and documents. It also discusses the various forensic microscope and Anthropology and the methodology of collecting & interpreting data for fingerprint application.

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

- Define the significance of forensic sciences. 1.
- 2. Observe and document crime scenes.
- 3. Categorise various forensic microscopes and Anthropology.
- 4. Describe the various sources of medical data related to forensic science.
- Demonstrate the visual analytical procedure of finger print application. 5.

BASICS OF FORENSIC SCIENCE UNIT 1

Forensic science, Introduction to the Forensic Sciences, History and Development of Forensic science, Deductive Reasoning, Organization of a Crime Laboratory Case Studies: The Enrique Camarena Case. A Forensic Nightmare Organization of forensic science laboratories of center and state -NCRA AND NICFS, fundamental rights, criminal profiling, concept of quality control management in forensic institutions. 9

UNIT 2 **OBSERVATION AND CRIME SCENE**

Observational Skills - Sherlock Holmes and Deductive Reasoning - Observations by Witnesses. Case Studies. The Crime Scene -Locard's Exchange Principle, Securing and Recording the Crime Scene, Legal Considerations at the Crime Scene, Evidence Collection and Recordation Techniques. Mock Crime Scene: Processing and Documenting a Crime Scene.

UNIT 3 FORENSIC MICROSCOPE AND ANTHROPOLOGY

Forensic Use of the Microscope -The Compound, Comparison, and Stereoscopic Microscope, The Scanning Electron Microscope (SEM). Forensic Anthropology- Introduction, Human Anatomy-The Skeletal System, Skeletal Determination of Demographic Data from Skeletal Remains, Determining Types of Trauma and Disease from Skeletal Remains, Case Studies.

UNIT 4 **BLOOD STAIN IDENTIFICATION**

Detection and identification of Blood stains, Determination of species of origin, Blood Group systems, Techniques of Determination of Blood groups of Blood stains, Determination of seminal and other fluids and their Blood Grouping, DNA, DNA Phenotyping and RNA Profiling & their applications. Wildlife forensics.

FINGERPRINT APPLICATION UNIT 5

Fingerprints -Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track marks, Case Studies.

TEXT BOOKS:

- Nanda, B.B. and Tewari, R.K. "Forensic Science in India: A vision for the twenty first century", Select 1. Publisher, New Delhi, 2001.
- 2. James, S.H and Nordby, J.J., "Forensic Science: An introduction to scientific and investigative techniques", CRC Press, 2003.

REFERENCES:

4.

- Adam B. Hall, Richard Saferstein, "Forensic Science Handbook", Volume I, Taylor & Francis Group, 1. Third Edition, 2020.
- Connie Darnell, "Forensic science in Healthcare: Caring for Patients, Preserving the Evidence", CRC 2. Press, Ist Edition, 2011.
- Sharma, B.R., Forensic Science in Criminal Investigation and Trials, Central Law Agency, Allahabad, 3. 1974

Prof. Nuzhat Parveen Khan & Ms. Bhavna Sharma, "Forensic Science & Indian Legal System", Central Law Publications, 1st Edition, 2022.

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TOTAL: 45 PERIODS

LTPC 3003

e-RESOURCES:

- 1. https://www.bcit.ca/computing-academic-studies/forensics/forensic-health-science/
- 2. https://www.shiksha.com/medicine-health-sciences/forensic-medical-science-chp

21BME51

Preamble

BioMEMS is the application of MEMS (Microelectromechanical Systems) technology in the fields of biomedical and health sciences. Due to their small size (1µm~1mm), BioMEMS have the advantages of low weight, low cost, quick response, high throughput, high efficiency, requiring much less sample/reagent, and easy system integration. BioMEMS found broad applications in disease diagnosis, prevention and treatment. Various bio-MEMS products have been developed, such as microfluidic devices, neural interface devices, µTAS (micro total analysis systems), lab-on-a-chip, DNA chips, micro drug delivery system, microsurgical tools, bio-sensors. This course introduces to students about the fundamentals of bio-MEMS technology, typical bioMEMS devices and their applications.

BIOMEMS AND NEMS

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Describe the principle, components and regulatory consideration of BioMEMS.
- 2. Explain the various Microfabrication techniques.
- Develop an appropriate method for identifying biomarkers using Microfluidic principles. 3.
- 4. Design and implementation of Microsensors and Microactuators for biomedical applications.
- Describe the fabrication and applications of NEMS technology. 5.

UNIT 1 INTRODUCTION TO BIOMEMS

BioMEMS, The Driving Force Behind Biomedical Applications, Biocompatibility, Reliability Considerations, Regulatory Considerations.

MICROFABRICATION UNIT 2

Silicon Microfabrication: Lithography. Etching Methods, Thin-Film Deposition Processes, Ion Implantation, Wet-Bulk Surface Micromachining, Dry-Bulk Surface Micromachining. Electroplating, Substrate Bonding. Soft Fabrication Techniques: Soft Lithography, Micromolding, Three-Dimensional Photopolymerization, Smart Polymers and Hydrogels.

MICROFLUIDIC PRINCIPLES AND MICRO-TOTAL-ANALYSIS SYSTEMS UNIT 3 (MTAS)

Transport Processes, Electrokinetic Phenomena, Microvalves, Micromixers, Micropumps. Micro-Total-Analysis Systems (mTAS): Lab-on-a-Chip, Capillary Electrophoresis Arrays (CEA), Surface Modification, Microspheres.

UNIT 4 MICRO SENSORS AND MICROACTUATORS

Optical Fibers, Piezoelectricity and SAW Devices, Electrochemical Detection, Applications in Medicine. Microactuators and Drug Delivery: Activation Methods, Microactuators for Microfluidics, Equivalent Circuit Representation, Drug Delivery.

UNIT 5 NEMS TECHNIQUES AND APPLICATIONS

Introduction to NEMS -Principles of operation - NEMS fabrication technologies - Applications in medical field.

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- Steven S. Saliterman, Fundamentals of BioMEMS and Medical Microdevices, SPIE Publications, 1. Jan. 19, 2006, ISBN: 0819459771.
- 2. Cornelius T. Leondes, MEMS/NEMS Handbook Techniques and Applications, Design Methods vol 1, 2006.

REFERENCES:

Mauro Ferrari (editor), BioMEMS and Biomedical Nanotechnology: I: Prospectus, Biological and 1. Biomedical Nanotechnology (A. Lee, L. Lee); II: Micro and Nano-Technologies for Genomics and Proteomics (M. Ozkan and M. Heller); III: Therapeutic Micro/Nanotechnology (T. Desai and

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S. Bhatia); IV: Biomolecular Sensing, Processing and Analysis (R. Bashid and S. Wereley), Springer, 1st edition, Nov. 30, 2006, ISBN: 0387255613.

- 2. Gerald Urban, BioMEMS (Microsystems), Springer, 1st edition, May 5, 2006, ISBN: 0387287310.
- 3. Wanjun Wang, Steven A. Soper, Bio-MEMS: Technologies and Applications, CRC Press, 1st edition, Dec. 15, 2006.

e-Resources:

- 1. http://scme-nm.org/files/SCME_MNT_BioMEMS_Workshop.pdf
- 2. http://www.isssonline.in/journal/03paper12.pdf

Illustrate the interaction of bio, nano materials with supporting materials and analyze the mobility, preservation.

Describe the biomolecules for drug delivery and identify the substitute material for artificial organs. 5.

Elucidate the principle of cell lines and interpret the types of growth factors, cellular matrix.

PRINCIPLES OF TISSUE ENGINEERING

INTRODUCTION TO TISSUE ENGINEERING UNIT 1

sciences to develop functional substitutes for damaged or diseased organs. Course Outcomes: Upon completion of the course, students will be able to:

Evaluate the functions of cellular tension, adhesion and migrations.

Introduction – Mesenchymal stem cell engineering, Fundamental principles, MSCs and hematopoietic support, cell targeting, Tissue engineering and morphogenesis, bone morphogenetic proteins, growth factors BMPs bind to extra cellular matrix- structure, function and applications. ECM and its properties, basement membrane, Focal adhesions.

Analyze the different material for scaffold fabrication and correlate the design with the immune responses.

Tissue engineering combines the principles of materials and cell transplantation to develop substitute tissues and promote endogenous regeneration. It combines the principles and technologies from the life, material and engineering

UNIT 2 **PROPERTIES OF BIOMATERIALS**

Mechanical forces on cells, cytoskeletal tension, scaffolds in regulating cellular tension – External mechanical forces in cell functions - cell adhesion - Adhesion receptors in tissue structures, Measurement of cell adhesion to biomaterials, Cell migrations - characteristics of mammalian cell migration, regulation of cell movement, cell migration assays.

UNIT 3 **TISSUE ENGINEERED DEVICES**

Inflammatory responses, immune responses, Natural polymer for scaffold fabrication, synthetic polymers for scaffold fabrication, scaffold design properties- ceramics for bone tissue engineering – chemico – physical properties of calcium phosphate ceramics, bone tissue engineering.

UNIT 4 **BIOMIMETIC MATERIALS**

Extra cellular matrices, bio adhesive materials, interaction with growth factors, proteases degradable material, artificial proteins, building elements, nano composite scaffolds for tissue engineering, nano composite materials, Molecular mobility and biopreservation.

RECENT TRENDS IN TISSUE ENGINEERING UNIT 5

Mechanisms of drug delivery, drug delivery in tissue engineering- Gene therapy, Nucleotides for delivery, gene delivery, cell and tissue, human skin substitutes - composition regulatory issues- Tissue engineering strategies.

TOTAL: 45 PERIODS

TEXT BOOKS:

21BME52

Preamble:

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- Joseph D.Bronzino" Tissue Engineering and Artificial Organs" Third Edition, Taylor and Francis, 2006. 1.
- 2. Robert Lanza, Robert Langer and Joseph vacanti"Principles of Tissue engineering" Third edition, Great science text books, 2007.

REFERENCES:

- Ulrich Meyer, Thomas Meyer, JorgHandschel, Hans peter Wiesmann "Fundamentals of tissue engineering and 1 regenerative medicine" Springer ,First Edition, 2009.
- Aldo R. Boccaccini, Julie E.Gough "Tissue engineering using ceramics and polymers" CRC PRESS, 2007 2.
- Angela K.Dillow, Anthony Lowman "Biomimetic materials and design" CRC PRESS, 2002. 3.
- 4. Sophie Bottcher -Haberzeth and Thomas Biedermann" Skin tissue engineering methods and protocols" First edition, Springer network, 2019

e-RESOURCES:

- https://www.youtube.com/watch?v=bgRjFW5agvA, "Introduction to tissue engineering" Prof. VigneshMuthuvijayan 1. Department of Biotechnology, IIT MADRAS.
- https://www.youtube.com/watch?v=AEWqAcSeQm4 "Nano-Biomimicry" Prof Dr.P.Gopinath, Department of 2. Biotechnology, IIT Roorkee.

LTPC 3003

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PRINCIPLES OF GENETIC ENGINEERING

LTPC 3003

Preamble: This course is designed to develop an understanding of fundamental and applied aspects of genetics and molecular biology which includes classical Mendalian genetics. Chromosome structure and organization DNA sequencing and Gene cloning.

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

- Explain the concept of Gene and gene inheritance. 1.
- 2. Describe the chromosome structure and organization in prokaryotes and eukaryotes.
- Choose the suitable techniques for isolation of DNA. 3.
- Discuss the principles of DNA sequencing and amplification techniques. 4.
- Apply appropriate enzyme, vector and techniques for gene cloning. 5.

UNIT 1 **FUNDAMENTALS OF GENETICS**

Classical genetics, Mendelian Laws- Mendel's experiment-monohybrid cross-phenotype,

genotype, Dihybrid inheritance, Interaction of genes, Fine structure of Genes

UNIT 2 **CHROMOSOMES**

Chromosome structure and organization in prokaryotes and eukaryotes, unusual chromosomes- chromosome banding, chromosome abnormalities- genetic disorders

RECOMBINANT DNA TECHNIQUES UNIT 3

Enzymes used in DNA technology, Isolation and purification of DNA (genomic and plasmid) and RNA, Electrophoresis: Agarose, PAGE, Pulse-field electrophoresis, capillary electrophoresis, 2D electrophoresis. 9

DNA SEQUENCING UNIT 4

Polymerase chain reaction and its applications, RTPCR, DNA sequencing, Oligonucleotide synthesis, Blotting techniques- Southern, northern and western.

GENE CLONING UNIT 5

Restriction enzymes: Recognition site and types, Cloning vectors: Plasmid, Bacteriophage, Cosmid, Human artificial chromosome, Cloning techniques, Genetic Engineering applications with examples.

TOTAL: 45 PERIODS

TEXT BOOKS:

1 P.S. Verma and V.K.Agarwal, "Genetics", 1st Edition, S.Chand and Company, Newdelhi, 2014

- R.W.Old and S.P.Primrose, "Principles of Gene manipulation: An Introduction to Genetic Engineering" 6th 2
- edition, blackwell scientific publications, New Jersey, 2003.

REFERENCES:

- Benjamin A. Pierce, Genetics: A Conceptual Approach, 6th edition, W. H. Freeman publication, 2016. 1
- Desmond S. T. Nicholl, An Introduction to Genetic Engineering, Cambridge University Press, 4th edition, 2023. 2 e-RESOURCES:
- NPTEL, https://nptel.ac.in/courses/102103013, "Genetic Engineering & Applications", Dr. Utpal Bora IIT 1 Guwahati

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TEXT BOOKS:

PHARMACEUTICAL ENGINEERING

Preamble

21BME54

This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

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

- Explain appropriate size reduction technology in drug manufacturing. 1
- 2. Discuss the fundamental concepts of evaporation and distillation of materials in Pharmaceutical industry
- Use the modern tools for mixing and drying of drug materials. 3.
- 4. Differentiate filtration and centrifugation techniques.
- Recognize the various categories of materials used in pharmaceutical industry. 5.

SIZE REDUCTION AND SEPARATION UNIT 1

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT 2 **EVAPORATION AND DISTILLATION TECHNOLOGY**

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

MIXING AND DRYING TECHNOLOGY UNIT 3

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier.

FILTRATION AND CENTRIFUGATION UNIT 4

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

MATERIALS OF PHARMACEUTICAL PLANT CONSTRUCTION, CORROSION UNIT 5 AND ITS PREVENTION

Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

Lecture : 45, Tutorial : 0, Total : 45

C.V.S. Subrahmanyam, "Pharmaceutical engineering Unit operations principles and practices", Vallabh 1. Prakashan, 2019.

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2. K Sambamurthy, "Pharmaceutical Engineering", New Age International (P) Limited, 2007.

REFERENCES:

- 1. Y. Sultana, "Unit Operations in Pharmaceutical Engineering", CBS Publishers & Distributors, 2018.
- 2. McCabe WL, Smith J.C and Harriott, "Unit operations of Chemical Engineering", McGraw Hill International Book Co. London, 2004
- 3. Girish K.Jani, "Pharmaceutical Engineering I, Unit Operation I", B.S.Shah Prakashan, India, 2006.

e-Resources:

- 1. ps://www.iit.edu/academics/programs/pharmaceutical-engineering-certificate, Pharmaceutical Engineering.
- 2. <u>https://in.coursera.org/learn/pharma-medical-device-innovations</u>, Prof. Stephen T Parente, Pharmaceutical and Medical Device Innovations.

BIOPHOTONICS

Preamble:

Biophotonics deals with interactions between light and biological matter. It is an exciting frontier which involves a fusion of photonics and biology. It offers great hope for the early detection of diseases and for new modalities of light guided and light activated therapies.

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

- Describe Photonic detection and imaging techniques for medical diagnostics using optical imaging 1. methods.
- 2. Characterize biological tissues using various spectroscopy techniques.
- Depict the principles of photodynamic therapy in treatment of skin disorders. 3.
- Explain the production and applications of LASER in medicine for diagnostic and therapeutic 4. intervention.
- Examine living cells using advanced photonic techniques for drug development. 5.

UNIT 1 PHOTONIC DETECTION AND IMAGING TECHNIQUES

Introduction to photonics. Physical phenomenon in tissue optics. Confocal microscopy, Two - photon excitation fluorescence microscopy, Near - field Imaging in biological and biomedical applications, Optical coherence tomography imaging, Speckle correlometry, Laser Doppler perfusion monitoring and imaging, Light scatter spectroscopy and imaging of cellular and sub cellular events, Thermal imaging for biological and medical diagnostics, Optical wave guide biosensors.

BIOMEDICAL DIAGNOSTICS UNIT 2

Functional imaging with diffusing light, Photon migration spectroscopy frequency -domain techniques, Atomic spectrometry in biological and clinical analysis, Fluorescence spectroscopy, Elastic - scattering spectroscopy and diffuse reflectance, Raman spectroscopy, Quantitative characterization of biological tissue using optical spectroscopy, Near - infrared fluorescence Imaging and Spectroscopy, Optoacoustic Tomography, Ultrasonically modulated optical imaging.

UNIT 3 **INTERVENTION AND TREATMENT TECHNIQUES**

Mechanistic principles of photo dynamic therapy, Synthetic strategies in designing porphyrin - based photo sensitizers for photodynamic therapy, Light Irradiation for photodynamic therapy-source-Light Dosimetry-Light delivery, Two photon Photodynamic therapy (PDT), Case study and clinical applications.

PRODUCTION AND APPLICATIONS OF LASER UNIT 4

Tissue engineering with Laser, Laser tissue welding, Lasers in interventional pulmonology, Lasers in urosurgery, Low - power laser therapy, Image - guided surgery, Optical methods for caries detection, Laser tweezers and scissors, diagnosis and therapeutic intervention.

ADVANCED BIOPHOTONICS FOR GENOMICS, PROTEOMICS, AND UNIT 5 **MEDICINE**

Recent developments in Fourier Transform Infrared (FTIR) Micro spectroscopic methods for biomedical analyses, Living- cells analysis using optical methods, Amplification techniques for optical detection, nanosensors for single - cell analyses. Advanced photonics: Optical trapping techniques in bio analysis, in vivo bioluminescence imaging as a tool for drug development.

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1. Tuan Vo Dinh, "Biomedical Photonics Handbook", 2nd edition, Volume 3, CRC Press, 2014.
- 2. David L. Andrews, Photonics, Volume 4, "Biomedical Photonics, Spectroscopy, and Microscopy", Wiley &Sons,2015.

REFERENCES:

- David A. Boas, ConstantinosPitris, and NimmiRamanujam, "Handbook of Biomedical Optics", 1. 1stEdition, CRC Press, 2011.
- 2. P. N. Prasad,"Introduction to biophotonics", John Wiley & Sons, Inc, 2003.
- 3. Markolf H. Niemz,"Laser-Tissue Interactions", Springer, 2007.

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e-RESOURCES:

https://nptel.ac.in/courses/117/108/117108037, "Biophotonics", Dr. Manoj Varma, IISc Bangalore. 1.

ANALYTICAL INSTRUMENTATION

Preamble:

Analytical instrumentation plays a dominant role in the estimation of bio chemical components in different chemical environment. This course familiarizes the fundamental principles, instrumentation and application of conventional and modern analytical techniques used in medical diagnosis.

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

- 1. Explain the principle and working of spectrophotometer used in medical diagnosis.
- 2. Choose the correct chromatography technique to separate the constituents from a complex mixture.
- 3. Suggest a suitable thermos and electrochemical instrument to measure the biochemicals.
- 4. Discuss the principles of operation of instruments that measure the products of combustion.
- 5. Compare the working principles of NMR and mass spectrophotometers.

UNIT 1 FUNDAMENTALS OF SPECTROPHOTOMETER

Electromagnetic spectrum, Interaction of radiation with matter, Laws relating to Absorption of radiation - Beer-Lambert's Law, Absorption instruments, Colorimeter, Types of Spectrophotometers – single and Double Beam Instruments, Infrared spectrophotometer.

UNIT 2 PRINCIPLES OF CHROMATOGRAPHY TECHNIQUES

Definition - Chromatography, Types of chromatography - Gas Chromatography, Liquid Chromatography and its types - Paper Chromatography, Thin Layer Chromatography, Column

Chromatography – Ion exchange chromatography, Gel permeation Chromatography, High Pressure Liquid Chromatography.

UNIT 3 THERMO AND ELECTROCHEMICAL INSTRUMENTS

Thermo analytical methods- Thermo Gravimetric Analysis, Differential thermal analysis, Differential scanning colorimetry, Electrochemical method and its types – Electrochemical cell, Types of electrode, Potentiometers, conductivity meters, voltammetry, polarographs, coulometer, Amperometers.

UNIT 4 BLOOD GAS ANALYZER

Principles of pH measurements, pH Electrode – Hydrogen, glass, calomel, Ag-Agcl electrode. pH meters, Ion Analyzer. Acid base balance, Measurement of Blood pH, pO2, pCO2. Infrared and thermal gas analyzer.

UNIT 5 NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETERS

NMR – Basic principles, Types of NMR spectrometer. Electron spin Resonancespectroscopy – Basic principles, Instrumentation and applications. Electron spectrometer – Basic principles, Instrumentation, Ion Spectroscopy – Instrumentation. Mass spectrometers – Different types and Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

- 1. R.S. Khandpur, Handbook of Analytical Instrumentation, 2nd Edition, McGraw Hill Education, Newdelhi, 2006.
- 2. Braun, R.D., Introduction to Instrumental Analysis, McGraw Hill, Singapore, 2006.

REFERENCES:

- 1. SabariGhosal, A.K. Srivastava, Fundamentals of Bioanalytical Techniques and Instrumentation, PHI Learning Private limited, 2013.
- G.W. Ewing, Instrumental Methods of Chemical Analysis, 5thEdition, 1985, McGraw HillBooks Co., New York.
- 3. Helmut Gunzler and Alex Williams, Handbook of Analytical Techniques, Wiley-VCH, Verlag, 2002.
- 4. J. Cazes, Ewing's Analytical Instrumentation Handbook, 3rd Edition, Marcel Dekker, 2005.

e-RESOURCES:

- 1. NPTEL,<u>http://nptel.ac.in/courses/103108100/#</u>, "Modern Instrumental Methods of Analysis", Prof. Dr. J.R. Mudakavi, IISc, Bangalore.
- 2. NPTEL, <u>http://nptel.ac.in/courses/104104066/</u>,"Advance Analytical Course", Prof. Dr. Padma S Vankar,
- ^{2.} IIT, Kanpur.

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21BME57

Preamble:

Biostatistics is a statistical science including methods of collecting, organizing and analyzing data in such a system that meaningful conclusions can be drawn from them. The data are obtainable in the form of tables and graphs. Statistics also deals with the processing of data devoid of attempting draw any Interfaces from it. The characteristics of the data are described in simple terms. It is a scientific restraint that uses mathematical tools to make forecasts and projections by analyzing the given data. This is for use to inhabitants employed in Biomedical engineering.

BIOSTATISTICS

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

- 1. Apply basic statistical concepts commonly used in health Sciences
- 2. Demonstrate the basic methods in Diagrammatic and Graphic Presentation of data.
- 3. Determine best measure of central tendency in a given circumstance.
- 4. Calculate the Dispersion, Skewness, Moments And Kurtosis for the given data
- 5. Apply statistical knowledge to design, conduct and interpret research studies

UNIT 1 CLASSIFICATION AND TABULATION OF DATA

Introduction, Meaning and Objectives of Classification, Objectives of Classification, Types of Classification, Geographical Classification, Chronological Classification, Qualitative Classification, Quantitative Classification, Formation of a Discrete Frequency Distribution, Formation of Continuous Frequency Distribution, Class Limits, Class Intervals, Class Frequency, Class Mid-Point or Class Mark, Considerations in the Construction of Frequency Distribution, Bivariate or Two-Way Frequency Distribution, Tabulation of Data, Difference Between Classification and Tabulation, Role of Tabulation, Parts of a Table, General Rules of Tabulation, Review of the Table, Types of Tables, Simple and Complex Tables, General and Special Purpose Tables.

UNIT 2 DIAGRAMMATIC AND GRAPHIC PRESENTATION

Introduction, Significance of Diagrams and Graphs, Comparison of Tabular and Diagrammatic Presentation, Difference Between Diagrams and Graphs, General Rules for Constructing Diagrams: Title, Proportion Between Width and Height, Selection of Scale, Footnotes, Index, Neatness and Cleanliness, Simplicity. Types of Diagrams: One-Dimensional or Bar Diagrams, Two-Dimensional Diagrams, Squares, Circles, Pictograms and Cartograms, Choice of a Suitable Diagram. Graphs: Technique of Constructing Graphs, Graphs of Time Series or Line Graphs, Rules for Constructing the Line Graphs on Natural Scale, Graphs of One Variable, Graph of Two or More Variables, Graphs Having Two Scales, Range Chart, Band Graph, Semi-Logarithmic Line Graphs or Ratio Charts, Interpretation of Logarithmic Curves. Graphs of Frequency Distributions: Histogram, Frequency Polygon, Smoothed Frequency Curve, Cumulative Frequency Curves or Ogives

UNIT 3 MEASURES OF CENTRAL VALUE

Introduction, Average Defined, Objectives of Averaging, Requisites of a Good Average. Types of Averages: Arithmetic Mean, Calculation of Arithmetic Mean—Continuous Series. Median: Calculation of Median—Continuous Series. Computation of Quartiles, Decides, Percentiles. Geometric Mean: Properties of Geometric Mean, Calculation of Geometric Mean—Individual Observations, Calculation of Geometric Mean—Discrete Series, Calculation of Geometric Mean—Continuous Series, Uses of Geometric Mean, Weighted Geometric Mean. Harmonic Mean: Calculation of Harmonic Mean—Individual Observations, Calculation of Harmonic Mean—Discrete Series, Calculation of Harmonic Mean—Continuous Series, Uses of Harmonic Mean, Weighted Harmonic Mean, Merits and Limitations of Harmonic Mean

UNIT 4 MEASURES OF DISPERSION, SKEWNESS, MOMENTS AND KURTOSIS

Introduction, Significance of Measuring Variation, Range, The Interquartile Range or the Quartile Deviation, The Mean Deviation: Calculation of Mean Deviation—Continuous Series, Merits and Limitations. The Standard Deviation: Calculation of Standard Deviation. Difference Between Dispersion and Skewness. Tests of Skewness, Measures of Skewness, Absolute Measures of Skewness, Relative Measures of Skewness, Bowley's Coefficient of Skewness, Kelly's Coefficient of Skewness, Measure of Skewness Based on the Third Moment. Moments: Moments About Arbitrary Origin, Conversion of Moments About an Arbitrary Origin Into Moments About Mean or Central Moments, Moments About Zero, Sheppard's Correction for Grouping Errors, Conditions for Applying Sheppard's Corrections, Measure of Skewness Based on Moments, Kurtosis, Measures of Kurtosis

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UNIT 5 CORRELATION ANALYSIS

Introduction, Significance of the Study of Correlation, Types of Correlation: Positive and Negative Correlation, Simple, Partial and Multiple Correlation, Linear and No-Linear (Curvilinear) Correlation. Methods of Studying Correlation: Scatter Diagram Method, Merits and Limitations of the Method, Graphic Method, Karl Pearson's Coefficient of Correlation, Calculation of Correlation in Grouped Data, Assumption of the Pearsonian Coefficient, Merits and Limitations of the Pearsonian Coefficient, Features of Spearman's Correlation Coefficient, Where Ranks are Not Given, Merits and Limitations of the Rank Method.

TEXT BOOKS:

TOTAL: 45 PERIODS

- 1 Gupta S.P (2021), Statistical Methods, 46th Edition, Sultan Chand & Sons, Educational Publishers, New Delhi
- 2 Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I
- & II, 8th Edn. The World Press, Kolkata.

REFERENCES:

- 1 Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
- 2 Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

e-RESOURCES:

1 <u>https://onlinecourses.nptel.ac.in/noc19_bt19/preview</u>Introduction to Biostatistics, By Prof. Shamik Sen, IIT Bombay.

21BME61 MODERN TRENDS IN PLANNING AND DESIGNING OF HOSPITALS L T P

Preamble

To understand the medical device standards, requirements, and design procedure of medical devices and to describe about the design realization, validation and verification of various medical devices

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Define the medical devices standards and requirements.
- 2. Summarize the concept of medical device development
- 3. Recall the engineering design and project metrics
- 4. Demonstrate the testing and validation of medical equipment.
- 5. Interpret the various design transfer and manufacturing methods

UNIT 1 HOSPITAL PLANNING

Principles of planning, regionalization, hospital planning team, planning process, size of the hospital, site selection, hospital architect, architect report, equipping a hospital, interiors & graphics, construction & commissioning, planning for preventing injuries, electrical safety.

UNIT 2 TECHNICAL ANALYSIS

Assessment of the demand and need for hospital services factors influencing hospital utilization-bed planning-land requirements-project cost-space requirements-hospital drawings and documents-preparing project report

UNIT 3 PLANNING & DESIGNING OF DIFFERENT SERVICES IN HOSPITALS

Planning and designing of administrative services, medical and ancillary services, nursing services, supportive services, public areas and staff services, hospital services.

UNIT 4 HOSPITAL STANDARDS AND DESIGN

Building requirement-entrance and ambulatory zone-diagnostic zone-intermediate zone-critical zone-service zoneadministrative zone-list of utilities-communication facility-biomedical equipment voluntary and mandatory standards-general standards-medical standards-electrical standards-standard for centralized medical gas systemstandards for biomedical waste.

UNIT 5 FACILITIES PLANNING

Transport, Information system, Communication, Food services, Mortuary, Heating Ventilation and Air Conditioning, Medical gases, House Keeping, Laundry.

TEXT BOOKS:

1. S.K.Gupta, S.kant, R.Chandrashekhar, S.Satpathy, Modern trends in planning and designing of hospitals: Principles and practice', Jaypee Brothers-Medical publishers, New Delhi, 2007.

2. G.Kunders, Hospitals- Facilities Planning & Management, Tata Mcgraw - Hill education-2004.

REFERENCES:

- 1. Purnima Sharma, Sangeet Sharma, Nerendra Malhotra, Jaideep Malhotra. Step by Step Hospital Designing and Planning, 2nd Edition, Jaypee Brothers-Medical publishers, New Delhi, 2010.
- 2. SA Tabish, Hospital and Nursing Homes planning, Organisation and Management, Jaypee Brothers-Medical publishers, New Delhi, 2003

Total : 45

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21BME62 ELECTRICAL SAFETY AND QUALITY ASSURANCE L T P C

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Preamble:

The Electrical Safety is to make an aware of the role of biomedical engineer in hospitals, especially in the management of electrical supply and maintenance of electrical safety. The quality assurance is to provide basic knowledge on the concept of Healthcare Quality management towards continuous improvement of patient care.

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

- 1. Acquire the knowledge of electrical safety and hazards in a commercial building and hospitals.
- 2. Realize the effect of electrical shock in the human body and implement the first AID for the affected person.
- 3. Acquire the knowledge of electrical safety during the installation, testing and commissioning of electrical equipments.
- 4. Discuss the need and significance of quality practices and improvement of quality in the health care.
- 5. Identify the basic requirements of regulations and accreditation process for the CE, FDA, ISO, JCI and NABH.

UNIT 1 INTRODUCTION TO ELECTRICAL SAFETY AND SAFETY MANAGEMENT

General Background of Electricity – General Safety Provisions in Indian Electricity Rules – OSHA Standards on Electrical Safety– Hazards Associated with Electric Current and Voltage– Types of Electrical Hazards – Effect of Electrical Current on the Human Body – Principles of Electrical Safety –Approaches to Prevent Accidents – Fire Prevention and Fire Fighting

UNIT 2 ELECTRICAL SHOCKS AND FIRST AID

Primary and Secondary Electric Shocks – Occurrence of Electric Shock– Possibility of Getting Electric Shock– Severity of Electric Shock– Medical Analysis of Electric Shock and Its Effects– AC Shocks Versus DC Shocks– Effect of Impulse Discharge through Human Body – Shocks Due to Flashovers/Spark-overs– Prevention of Shocks– Installation of Earthing System–Functional Requirements of Earthing System – Neutral Grounding – First AID– First Principles of Actions After Electric Shock– Cardiac Pulmonary Resuscitation

UNIT 3 SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE

Preliminary preparations – Safe Sequence During Installation – Risks During Installation of Electric Plant and Equipment Safety Documentation for Installation – Field Quality and Safety During Erection –personal protective equipment – Steps in Commissioning - Zone wise Testing and Commissioning- safety clearance notice – safety precautions – Safeguards for Operators Safety – Types of Maintenance and Safety Process-Safety Precautions.

UNIT 4 QUALITY MEDICAL CARE IN HOSPITALS

Quality – Dimensions of Quality in Healthcare – Evaluation of the concepts of quality – Present International and Indian scenario – Essentials of quality improvement in healthcare – improvement of quality in healthcare - implementation of quality management program

UNIT 5 REGULATORY REQUIREMENT FOR HEALTH CARE

CE and FDA regulations, Accreditation for hospitals -ISO, JCI, NABH and NABL - Other regulatory Codes.

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1. S. Rao, R.K. Jain, H.L. Saluja,"Electrical Safety, Fire Safety Engineering And Safety Management", Khanna Publishers, Second Edition, 2012.
- 2. Joshi S. K., "Quality Management in Hospitals", Jaypee Brothers Medical Publishers, 2008.

REFERENCES:

1. Joseph F.Dyro, "Clinical Engineering Handbook", Elsevier Publishers, 2004.

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- Sharon Myers, "Patient Safety & Hospital Accreditation A Model for Ensuring Success", Springer Publishers, 2012.
 e-RESOURCES:
- https://nptel.ac.in/courses/103/106/103106071/#Lecture-5-Electrical-Safety-Hazard.html. 1.

MEDICAL ETHICS AND STANDARDS

Preamble

21BME63

This course is to achieve familiarity with some basic ethical framework& understand how these ethical frameworks can help us to think through contemporary questions in medical ethics. The course gives knowledge about the legal and ethical principles and application of these principles in health care settings. It helps the students gain knowledge about the medical standards that to be followed in hospitals.

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

- Identify the scope of medical ethics 1.
- Illustrate the concepts of ethical theories and moral principles for the health professions 2.
- Explain the purpose of medical standards 3.
- Acquire knowledge about hospital accreditation standards and Summarize the importance of hospital 4. safety standards
- Recommend the suitable principles of medical equipment safety standards in hospitals 5.

UNIT 1 INTRODUCTION TO MEDICAL ETHICS

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and the Patient, The Doctor and the Profession, Professional Independence, The Doctor and Society.

ETHICAL THEORIES AND MORAL THEORIES UNIT 2

Theories-Deontology & Utilitarianism, Casuist theory, Virtue theory, The Right Theory. Principles Non Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research, Bioethical issues in Human Genetics & Reproductive Medicine

UNIT 3 MEDICAL STANDARDS

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 4 HOSPITAL ACCREDITATION AND SAFETY STANDARDS

Accreditation - JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards - Indian Perspective. Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

UNIT 5 MEDICAL EQUIPMENT SAFETY STANDARDS

General requirements for basic safety & essential performance of medical equipment. IEC 60601 standards .Base Standard-general requirement of electrical medical devices, Collateral Standards EMC radiation protection & programmable medical device system, Particular Standards-type of medical device.

Lecture: 45, Tutorial: 0, Total: 45

TEXT BOOKS:

- 1. Daniel A Vallero, "Biomedical ethics for Engineers", Elsevier publication, 1st edition, 2007.
- 2. JohnnaFisher, "Biomedical Ethics: A Canadian Focus." Oxford University Press Canada 2009. **REFERENCES:**
- 1. NilsHoppe and Jose Miola, "Medical law and Medical Ethics", Cambridge University Press, 2014
- Robert M Veatch," Basics of Bio Ethics", Second Edition. Prentice- Hall, Inc, 2003. 2.

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e-Resources:

- 1. https://nptel.ac.in/courses/109106092/, "Issues in Bioethics",Dr. Sreekumar Nellickappilly, IIT, Madras .
- 2. https://onlinecourses.nptel.ac.in/noc22_mg95/, " Ethics In Engineering Practice", Prof. Susmita Mukhopadhyay , IIT, Kharagpur .

FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT LTPC **21BME64**

Preamble:

This course aims to introduce the 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.

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

- 1. Define, formulate and analyze a problem.
- 2. Solve specific problems independently or as part of a team.
- Gain knowledge of the Innovation & Product Development process in the Business Context. 3.
- 4. Work independently as well as in teams.
- 5. Manage a project from start to finish

UNIT 1 FUNDAMENTALS OF PRODUCT DEVELOPMENT

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 9

UNIT 2 **REQUIREMENTS AND SYSTEM DESIGN**

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 3 **DESIGN AND TESTING**

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 4 SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT

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 5 **BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY**

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

TEXT BOOKS:

- Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGrawHill, 5th Ed, 2011. 1.
- John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2007. 2.

REFERENCES:

- Hiriyappa B, "Corporate Strategy Managing the Business", Author House, 2013. 1.
- Peter F Drucker, "People and Performance", Butterworth Heinemann [Elsevier], Oxford, 2005. 2.
- 3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning -Concepts", Second Edition, Prentice Hall, 2011.



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

BIOMEDICAL WASTE MANAGEMENT

Preamble:

21BME65

This course helps the students to understand the significance of infections, biomedical waste and its proper handling, storage and disposal. Also this course gives the knowledge about the technologies, safety and risk factors involved in treatment and disposal of biomedical wastes.

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

- Explain the basic concepts, regulations and standards involved in the waste management for effective 1. disposal of medical waste.
- 2. Describe the handling and storage methods involved in hospital for disposal of infectious medical waste.
- Summarizing the technologies used in the treatment of hospital medical waste for the hazardous free 3. environment.
- 4. Explain the methods involved in the disposal of biomedical waste to create infection free zone around the hospital.
- 5. Describe the challenges and safety measures involved in managing the hazardous waste for effective operation of the hospital.

UNIT 1 **INTRODUCTION**

Understanding waste and waste management - Basic waste management concepts - risks of infectious and medical wastes - national waste management trends - objectives of waste management -regulations and standards for infectious and medical waste management.

UNIT 2 **IDENTIFICATION, HANDLING AND STORAGE OF MEDICAL WASTE**

Identifying infectious waste - types of infectious waste- containers and packaging-Containment of Sharps, Containment of Solid Wastes, Containment of Liquids-waste handling practices-Waste Collection, Waste Storage - treatment consideration- Onsite Treatment of Infectious Waste, Offsite Treatment of Infectious Waste. 9

UNIT 3 MEDICAL WASTE TREATMENT TECHNOLOGIES

Steam sterilization (autoclave)- conditions required, operation, exposure period, factors that interfere with waste heating – incineration – working, destruction efficiency, incineration engineering and operation- thermal inactivation/sterilization - gas sterilization-chemical disinfection-irradiation- management of chemical wastes - management of radioactive waste.

UNIT 4 DISPOSAL AND MINIMIZATION OF TREATED WASTE

Landfill disposal - incinerator ash, sharps, pathological wastes, red bags - discharge to the sanitary sewer system – minimizing infectious waste- source separation, volume and weight reduction techniques.

UNIT 5 SAFETY AND RISK ANALYSIS

Occupational Safety for Waste Management-Preparing for Hazardous Material Emergencies - Training Staff and Waste Handlers- Essential Components of Effective Waste Management.

TOTAL : 45 PERIODS

TEXT BOOKS:

Gordon, Judith G. Reinhardt, Peter A, "Infectious and medical waste management", CRC press, 2016. 1.

REFERENCES:

- Jorge Emmanuel, Charles J. Puccia, Robert A. Spurgin, "Non-incineration medical waste treatment 1. technologies", health care without harm,2011.
- C.R.BRUNNER, "Medical Waste Disposable Handbook", Incentrated, Consultant in Corporated, 2. Virginia, 2000.

e-RESOURCES:

https://dth.ac.in/medical/courses/Microbiology/block-9/3/index.php, "Biomedical its 1 waste and management", Nptelcourse, IIT Madras.

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 <u>https://gmch.gov.in/e-study/e%20lectures/Community%20Medicine/Biomedical%20Waste%20</u> <u>Management.pdf</u>, "Biomedical waste management", Dr. NAVPREET,Govt. Medical College & Hospital, Chandigarh.

21BME66 TROUBLESHOOTING OF MEDICAL EQUIPMENT

Preamble

To understand the troubleshooting of electrical and electronic and medical equipment and is to apply the tools in design, testing and developing medical equipment.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Identify the reasons for equipment failure due to electric circuits.
- 2. Interpret the need for calibration, maintenance and troubleshooting of PCB.
- 3. Identify the methods of troubleshooting of medical equipment.
- 4. Explain the maintenance of the medical equipment.
- 5. Analyze the quality and safety standards

UNIT 1 TESTING OF ELECTRICAL EQUIPMENT

AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing-Earthing –Earth wires - Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring-Megger-Testing equipment and instruments.

UNIT 2 TESTING OF ELECTRONIC COMPONENTS

Troubleshooting of PCB, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse.

UNIT 3 TROUBLESHOOTING OF MEDICAL EQUIPMENT

Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools. Troubleshooting of X-ray machines, ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

UNIT 4 LIFE CYCLE MANAGEMENT OF MEDICAL EQUIPMENT

Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle. Case study.

UNIT 5 RELIABILITY IN MEDICAL DEVICES

Need for reliability, Tools for reliability assurance, MTBF, MTTR, FMEA, Fault tree analysis, Markov method, cause failure analysis. Human errors in healthcare systems, human factors approach to reduce error. Computerized Maintenance management system for medical equipment.

TEXT BOOKS:

- 1. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment", McGraw Hill Professional edition, 2013.
- 2. R. S. Khandpur, "Troubleshooting Electronic Equipment" 1st Edition, McGraw Hill, 2007.
- 3. Keith Willson, Keith Ison, Slavik Tabakov, "Medical equipment management", CRC Press, UK, 2014

REFERENCES:

- 1. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York,4thedition, 2008.
- 2. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment", McGraw Hill Professional edition, 2013.

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Total: 45

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21BME67 MEDICAL DEVICE STANDARDS AND REGULATION L T P C

Preamble

The course showcases the Quality management system and the standards for medical devices .The students are able to enumerate the compatibility standards for medical devices and describe the medical device regulations . Also the Students are able to list the steps taken for usability testing.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Discuss the safety and standardization of medical devices.
- 2. Acquire the knowledge of compatibility standards for medical devices.
- 3. Describe the medical device regulation and its implications on medical Equipment,
- 4. Extend the classification of medical devices for different countries.
- 5. Explain the procedure about Usability Testing.

UNIT 1 STANDARDS AND SAFETY

Quality management system for medical devices -ISO 9001 and ISO13485, Safety and Standardization for Risk management -ISO 14971, European standard conformity (CE marking), FDA guidelines for medical devices approval and classification based on risk assessment.

UNIT 2 COMPATIBILITY STANDARDS FOR MEDICAL DEVICES

Evaluation of biocompatibility of medical devices-ISO 10993 Series, Electromagnetic compatibility standards of medical equipment -IEC 60601 series, Medical device software -IEC 62104.

UNIT 3 MEDICAL DEVICE REGULATION

Medical device and in vitro diagnostics: Introduction & types of devices including combination devices. Medical Device Rules, 2017: Implications on medical devices. Classification of medical devices. Labeling of medical devices and in vitro diagnostics.

UNIT 4 CLASSIFICATION OF MEDICAL DEVICES

Classification of medical devices in United States - Class I, Class II, Class III. Classification of medical devices in Canada - Class I, Class II, Class III, Class IV. Classification of medical devices in United Kingdom : class I, Class IIa, Class IIb and Class III. Classification of medical devices in India-Class A, Class B, Class C and Class D.

UNIT 5 USABILITY TESTING

Introduction -Usability testing and Risk management -common elements of usability test-types of test - conducting, documenting and analyzing the test. Design validation

Lecture:45, Tutorial:0, Total: 45

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TEXT BOOKS:

- 1. Seeram Ramakrishna, Lingling Tian, Charlene Wang, Susan Liao, Wee Eong Teo, Medical Devices Regulations, Standards and Practice, Wood head Publishing, 1st Edition, 2015.
- 2. MDR17, Regulation of Medical Devices.
- 3. Usability Testing of Medical Devices Michael E. Wiklund P.E., Jonathan Kendler, Allison Y. Strochlic CRC Press, 20-Dec-2010
- 4. Use of International Standard ISO 10993-1, "Biological evaluation of medical devices Part 1: Evaluation and testing within a risk

REFERENCES:

- 1. Joseph D. Nally (ed.), Good Manufacturing Practices for Pharmaceuticals ,CRC Press sixth edition, 2007.
- 2. Joint Commission International Accreditation Standards for Hospitals, Joint Commission International, 6th Edition, 2017.

e-RESOURCES:

- 1. https://cdsco.gov.in/opencms/export/sites/CDSCO_WEB/Pdf-documents/medicaldevice/Classificationg1.pdf
- 2. https://patientguard.com/medical-devices-classification-uk/
- 3. https://www.iso.org/obp/ui/#iso:std:iec:62366:-1:ed-1:v1:en
- 4. https://link.springer.com/book/10.1007/978-3-030-91855-2#toc
- 5. Regulatory requirements for medical devices including in vitro diagn

BIOTELEMETRY

21BMO01

Preamble

The course introduces biotelemetry and its applications. It also details the need for biotelemetry and explains various biomedical telemetry systems. Additionally the course exposes the need and usage of telemedicine technology.

Course Outcomes: Upon completion of this course, students will be able to:

- Explain the principles and applications of biotelemetry systems. 1.
- Describe the wireless biomedical telemetry systems. 2.
- 3. Identify the implantable biomedical telemetry systems using multi-channel telemetry.
- Explain the need for biotelemetry and patient safety systems. 4.
- Interpret the applications of telemedicine using various telemedicine technologies. 5.

UNIT 1 INTRODUCTION TO BIOTELEMETRY

Introduction – Biotelemetry systems – transducers, interface electronics, wireless communication, power source, packaging and encapsulation. Applications - diagnostic, therapeutic and rehabilitive microsystems.

UNIT 2 BIOMEDICAL TELEMETRY - I

Wireless telemetry - modulation systems, choice of radio carrier frequency, transmitter, receiver. Single channel telemetry system-ECG Telemetry system, temperature telemetry sysostics in India (Version 2.0), IIT Madras, Prof. Arun B.Ramteke, Prof. Aseem Sahu, Prof. Malay Mitra. https://nptel.ac.in/courses/127106136tem. Multi-channel wireless telemetry system - telemetry of ECG and respiration, obstetrical telemetry system, telemetry in operating rooms, sports physiology studies through telemetry. 9

UNIT 3 BIOMEDICAL TELEMETRY - II

Multi-patient telemetry.Implantable telemetry systems -implantable telemetry system for blood pressure and blood flow. Transmission of analog physiological signals over telephone - multi-channel patient monitoring telephone telemetry system

UNIT 4 BIOTELEMETRY AND PATIENT SAFETY

Need for biotelemetry, physiological effects of electrical current – shock hazards from electrical equipments, electrical accidents and their prevention.

UNIT 5 TELEMEDICINE TECHNOLOGY

Essential parameters for telemedicine, telemedicine technology, video conferencing, digital communication systems, telemedicine using mobile communication, use of internet resource for telemedicine.

TEXT BOOKS:

- Khandpur, "Handbook on Biomedical Instrumentation", Tata McGraw Hill Company, New Delhi, 2003. 1.
- Joseph J Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson 2. Education Asia.NewDelhi.Fourth edition.2003.

REFERENCES:

- John G Webster, Ed, "Medical Instrumentation Application and Design", Fourth edition, John Wiley & 1. Sons, Singapore, 2007.
- Leslie Cromwell, Fred J. Webell, Erich A. Pfeffer, "Bio-medical Instrumentation and Measurements", 2. Prentice Hall of India, New Delhi, 2001

e-RESOURCES:

- https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/biotelemetry 1.
- https://www.researchgate.net/publication/11376144 Theory and Applications of Biotelemetry 2.
- https://www.ncbi.nlm.nih.gov/pubmed/11993572/theory and applications of biotelemetry 3.
- https://www.spiedigitallibrary.org/conference-proceedings-of-pie/1355/0000/Principles-and-applications-4. of-biotelemetry/10.1117/12.23858.short?SSO=1
- https://link.springer.com/article/10.1023/A:1014862027454 5.

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Total: 45

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21BMO02 BIOMETRIC SYSTEMS AND THEIR APPLICATIONS

Preamble:

Biometric system helps to impart the knowledge on design of biometric systems and the underlying trade-offs. Also it enables the students to understand the technologies in fingerprint, iris, face recognition and hand geometry.

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

- 1. Demonstrate knowledge on biometric authentication system using biometric applications.
- 2. Explain the fingerprint technology using fingerprint enhancement, feature extraction, classification and matching technique used for criminal application.
- 3. Design face recognition system using neural network, video sequences used for various biometric applications
- Describe about iris recognition and hand geometry using segmentation and feature extraction
- 4. technique used for commercial application.
- 5. Identify issues in multimodal biometrics using face and ear used for biometric application.

UNIT 1 BIOMETRICS SYSTEM

History of Biometrics – Types of Biometric Traits – General Architecture of Biometric Systems – Basic working of Biometric matching – Biometric system error and performance measure.

UNIT 2 FINGERPRINT BIOMETRICS

Finger print using vein pattern of palm – Fingerprint Biometrics – Fingerprint recognition system – minutiae extraction – advantage and disadvantages of fingerprint biometrics.

UNIT 3 FACE RECOGNITION

Background of face recognition – design of face recognition system - neural network for face recognition – face detection in video sequences – face recognition methods.

UNIT 4 IRIS RECOGNITION & HAND GEOMETRY

Design of iris recognition system – iris segmentation method – application of iris biometrics – basics of hand geometry – image capturing, hand segmentation, feature extraction.

UNIT 5 MULTIMODAL BIOMETRICS & BIOMETRIC APPLICATIONS

Basic architecture of multi model biometrics – multi model biometrics using face and ear – multi model biometrics application – case study of biometric application.

TEXT BOOKS:

1. G.R.Sinha, SandeepB.Patel, "Biometrics:Concepts and Applications", Wiley Publicatios, 1st edition,2013.

REFERENCES:

- 1. James Wayman, Anil Jain, DavideMaltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005
- 2. Arun A Ross, KarthikNandakumarand Anil K.Jain, "Handbook of Multibiometics", Springer,2006 e-RESOURCES:
- 1. http:// NPTEL/biometrics- IIT-kanpur, "Biometric Systems", Prof. PhalguniGupt , IIT, khanpur.

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22BMO03

Preamble

The purpose of this course is to provide a basic understanding of biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.

BIOLOGY FOR ENGINEERS

Course Outcomes: Upon completion of this course, students will be able to:

- Explain the cells, its structure and function, and Different types of cells and basis for
- ^{1.} Classification of living organisms.
- 2. Explain about bio molecules its structure and function and their role in a living organism.
- 3. Express the concept of biology and its uses in combination with different technologies for production of medicines and production of transgenic plants and animals.
- 4. Illustrate about genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms.
- 5. Discuss the importance of vaccines, biosensors in bio engineering and applications of tissue engineering.

UNIT 1 BASIC CELL BIOLOGY

Cell theory, Cell shapes, structure of a Cell, Cell cycle chromosomes

The Plant Cell and animal Cell, protoplasm, prokaryotic and eukaryotic Cell, Plant Tissue and Animal Tissue. Brief introduction to five kingdoms of classification.

UNIT 2 INTRODUCTION TO BIO-MOLECULES

Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types.

Enzymes and their application in Industry. Large scale production of enzymes by Fermentation. Biological Diversity --Chemistry of life: chemical bonds--Biochemistry and Human biology--Protein synthesis—Stem cells and Tissue engineering.

UNIT 3 HUMAN PHYSIOLOGY

Nutrition (Classes of nutrients or food substances), Digestive systems, Respiratory system (two kinds of respiration – aerobic and anaerobic) Respiratory organs, respiratory cycle. Excretory system.

UNIT 4 GENES, REPLICATION OF DNA, AND INTRODUCTION TO 9 RECOMBINANT DNA TECHNOLOGY

Prokaryotic gene and Eukaryotic gene structure, gene replication, Transcription and Translation in Prokaryote and Eukaryote and synthesis of protein in Eukaryotes. Recombinant DNA technology and cloning introduction.

UNIT 5 APPLICATION OF BIOLOGY

Brief introduction to Production of vaccines, Enzymes, antibodies, Cloning in microbes, plants and animals, Basics of biosensors, biochips, Bio fuels, and Biosensors. Tissue engineering and its application, transgenic plants and animals, Bio engineering (production of artificial limbs, joints and other parts of body).

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "Biology for Engineers," Tata McGraw-Hill, New Delhi, 2012.
- 2. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
- 3. T Johnson, Biology for Engineers, CRC press, 2011 Molecular Biology and Biotechnology 2nd ed. J.M. Walker and E.B. Gingold. Panima Publications. PP 434.

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REFERENCES:

- 1. Jeremy M. Berg, John L. Tymoczko and LubertStryer, "Biochemistry," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
- 2. Robert Weaver, "Molecular Biology," MCGraw-Hill, 5th Edition, 2012.
- 3. Jon Cooper, "Biosensors A Practical Approach" Bellwether Books, 2004.

e-Resources:

- 1. https://nptel.ac.in/courses/121/106/121106008/, 'Biology For Engineers and Othernon-Biologists ' Prof. Suraishkumar & Prof. Madhulika Dixit, IIT Madras.
- 2. https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- 3. https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- 4. https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006

21BMO04

HEALTHCARE MANAGEMENT SYSTEMS

Preamble:

The course covers the basic process of hospital planning. It also covers topics on planning, organizing, directing and controlling of the individual clinical and various supportive departments of the hospital. The course also develops understanding of hospital safety and security systems.

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

- 1. Describe the basic planning and organization of hospitals using guiding principles.
- 2. Explain the roles and responsibilities in Hospital Administration and Human Resource management with organizational hierarchy.
- 3. Identify and explain the role of medical and support services used for proper functioning of the hospitals.
- 4. Interpret various Engineering and other essential services of a hospital.
- 5. Identify and explain the key elements of security and safety management in Hospitals.

UNIT 1 HOSPITAL PLANNING

Roles of hospital in healthcare-Planning the Hospitals – Guiding principles in planning hospital facilities and services –Preliminary survey – Financial planning – Equipment Planning – Purchase of capital equipment.

UNIT 2 ORGANIZATION AND HOSPITAL OPERATION MANAGEMENT

Organizational structure - Management Structure – Organizational Charts– Professional management – Recruitment and selection – Orientation, training and selection.

UNIT 3 MEDICAL AND SUPPORTIVE SERVICES

Outpatient services – Clinical Laboratory services – Surgical Department – Hospital Information System - Medical Records - Pharmacy – Central Sterile Supply Department (CSSD) - Materials Management.

UNIT 4 DESIGNING OF HOSPITAL SERVICES

Engineering department - Maintenance management- Clinical engineering – Electrical system- Air conditioning system- Water supply and sanitary system – Centralized medical gas system.

UNIT 5 HOSPITAL SAFETY AND SECURITY

Safety in hospital – Security and loss prevention programme – Fire safety- Alarm system- Disaster management.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. G.D.Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:

- 1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI Fourth Edition, 2006.
- 2. B.M. Sakharkar, "Principles of hospital administration and planning", Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.
- 3. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.

e-RESOURCES:

- 1.https://www.youtube.com/watch?v=ZZS8-ySBNFM, "Organisation and Management of Hospital", Prof.
S.B.Aroara, Professor, School of Health Sciences,
Indira Gandhi National Open University (IGNOU), MaidanGarhi, New Delhi.
- 2. http://www.nptelvideos.in/2012/11/human-resource-management-i.html, "Lecture Series on Human Resource Management-I", Prof.KalyanChakravarti, Vinod Gupta School of Management, IIT Kharagpur.

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21BMO05

Preamble:

Medical Robotics course is to familiarize the students with the concepts, techniques and various drive systems for robot, sensors and their applications in robots and programming of robots.

MEDICAL ROBOTICS

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

- 1. Categorize the robots and actuators to move and control the system.
- 2. Identify the sensors like acceleration, light, proximity, touch and sniff for a robot to estimate the environmental condition.
- 3. Illustrate the mechanism of robots using forward and inverse kinematics methods.
- 4. Examine the motion of robot and prepare the trajectory of a robot using jacobian and lagrangian mechanics.
- 5. Explain the advancement of robotics in medicine.

UNIT 1 ROBOTICS AND THEIR CLASSIFICATION

History of robots - Classification - Robot coordinates- Reference frames- Programming modes- Characteristics of robot- Actuators - Characteristics of actuating systems, hydraulic actuators, pneumatic devices, electricmotors.

UNIT 2 SENSORS

Sensors, characteristics of sensor, position sensors, velocity sensors, acceleration sensors, force and pressure sensors, torque sensors, light and infrared sensors, touch and tactile sensors, proximity sensors, range finders, sniff sensors, vision systems, voice recognition devices, voice synthesizers.

UNIT 3 ROBOT KINEMATICS

Robots as mechanisms, matrix representation, homogeneous transformation matrices, representation of transformations, inverse of transformation matrices, Forward and inverse kinematics of robots, DH representation of forward kinematic equations of robots, inverse kinematic solution of robot. Inverse kinematics programming of robots, degeneracy and dexterity.

UNIT 4 ROBOT DYNAMICS

Differential motions of a frame, differential changes between frames, calculation of the jacobian – Inverse jacobian, lagrangian, lagrangian mechanics of spring cart system, and degrees of freedom robot arm trajectory planning: introduction - Path vs trajectory - Joint-Space vs Cartesian-Space Descriptions- Basics of trajectory planning -Joint-Space trajectory planning.

UNIT 5 CASE STUDIES

Biomedical Image Analysis on Wireless Capsule Endoscopy Images and Videos, Cooperative Control Designin Drug Delivery, Cancer Targeted Therapy, Catheter Surgery System.

- 1. Saced B. Niku"Introduction to Robotics Analysis, Systems, Applications", Prentice Hall of India/Pearson Education, 2002.
- 2. Yi Guo "Selected Topics in Micro/Nano-Robotics for Biomedical Applications", 2013.

REFERENCES:

TEXT BOOKS:

- 1. Craig, "Introduction to Robotics Mechanics and Control", Pearson Education, 2nd Edition, 2004.edition,2013.
- 2. Mittal.R.K and Nagrath.I.J "Robotics and Control", McGraw Hill, 2003.
- 3. Fu.K.S. & Co., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill International Editions, Industrial Engineering Series, 1991.
- 4. Klafter.R.D, T.A. Chimielewski and M.Negin "Robotic Engineering An integrated Approach", Prentice Hall of India, 2002.

e-RESOURCES:

1. <u>https://onlinecourses.nptel.ac.in/noc21_me61/preview</u>

TOTAL: 45 PERIODS

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RAPID PROTOTYING

21BMO06

Preamble

The course aims to provide an understanding of all the expected requirement of product are addressed and if required, its performance is also assessed from the prototype. Rapid prototyping offers a convenient option for manufacturing of product or its prototype from the CAD model.

Course Outcomes: Upon completion of this course, students will be able to:

- 1. Describe the basics of Rapid Prototyping and its systems.
- 2. Explain the concept of process chain & liquid-based rapid prototyping systems.
- 3. Explicate the working principle of solid-based rapid prototyping systems with its applications.
- 4. Enumerate the process, principle and application of powder based rapid prototyping systems.
- 5. Discuss the rapid prototyping data formats and standard for representing layered manufacturing objects.

UNIT 1 INTRODUCTION TO PROTOTYPE

Prototype Fundamentals – Historical Development – Three Phases of Development Leading to Rapid Prototyping – Fundamentals of Rapid Prototyping – Advantages of Rapid Prototyping – Classification of Rapid Prototyping Systems

UNIT 2 PROCESS CHAIN & LIQUID-BASED RAPID PROTOTYPING SYSTEMS 9 Fundamental Automated Processes – Process Chain –3D Systems' Stereolithography Apparatus (SLA) – Process – Principle, Applications – Cubital's Solid Ground Curing (SGC) – Process – Principle, Applications – D-Mec's Solid Creation System (SCS) – Process – Principle, Applications – Cmet's Solid Object Ultraviolet-Laser Printer (SOUP) – Process – Principle, Applications.

UNIT 3 SOLID-BASED RAPID PROTOTYPING SYSTEMS

Cubic Technologies' Laminated Object Manufacturing (LOM) – Process – Principle, Applications Stratasys' Fused Deposition Modeling (FDM) – Process – Principle, Applications – Kira's Paper Lamination Technology (PLT) – Process – Principle, Applications –3D Systems' Multi-Jet Modeling System (MJM) — Process – Principle, Applications Solidscape's Modelmaker And Patternmaster – Process – Principle, Applications – The Shape Deposition Manufacturing Process – Process – Principle, Applications

UNIT 4 POWDER-BASED RAPID PROTOTYPING SYSTEMS

3D Systems' Selective Laser Sintering (SLS) – Process – Principle, Applications – EOS's Eosint Systems– Process – Principle, Applications – Soligen's Direct Shell Production Casting (DSPC) – Process – Principle, Applications – Fraunhofer's Multiphase Jet Solidification (MJS) – Process – Principle, Applications – Therics Inc.'s Theriform Technology– Process – Principle, Applications – Extrude Hone's Prometal 3D Printing Process– Process – Principle, Applications

UNIT 5 RAPID PROTOTYPING DATA FORMATS

STL Format – STL File Problems – Consequences of Building a Valid and Invalid Tessellated Model – STL File Repair- Generic Solution – Special Algorithms – Performance Evaluation – Other Translators – Standard for Representing Layered Manufacturing Objects

Lecture : 45, Tutorial : 0, Total : 45

TEXT BOOKS:

- 1. Chua C.K., Leong K.F. and Lim C.S., "Rapid Prototyping: Principles and Applications", Second Edition, World scientific publications, 2003.
- 2. Chua C.K., Leong K.F. and Lim C.S., "Rapid Prototyping: Principles and Applications", Third Edition, World scientific publications, 2010.

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REFERENCES:

- 1. Pham, D.T. and Dimov.S.S., "Rapid manufacturing", Springer, London, 2001.
- 2. Roger Narayan, "Rapid prototyping of biomaterials: Principles and applications", First Edition,
- ^{2.} Woodhead Publishing ,2014

e-RESOURCES:

- 1. https://archive.nptel.ac.in/courses/112/104/112104265/ Rapid Prototyping, Prof. J.Ramkumar,IIT Kanpur
- 2. https://nptel.ac.in/courses/112104204/47, Prof. Shantanu Battacharya, IIT Kanpur.

21BMV01

Prerequisite:

Knowledge of Communication network and Programming Languages.

Preamble:

Industrial Internet of things is the network of physical objects that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. This course aims to impart knowledge about the implementation of IOT among the student community.

INDUSTRIAL INTERNET OF THINGS

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

- 1. Understand the basics of IoT architecture and its communication protocols
- 2. Develop python programming in IoT applications using Raspberry Pi and ESP

Module 1 – Introduction to IOT and Python Programming

- Introduction to IoT
- Enabling technologies •
- **Open Architecture** •
- Communication protocols •
- HTTP 6LowPAN CoAP MOTT •
- **PYTHON Programming** •
- Linux on Raspberry Pi •
- Accessing Internet •
- SMTP mail server •
- Creating a project on security using cryptography
- HTML Programming •

Module 2 – Application Using Raspberry PI and ESP Processors

- Interfacing of Analog Sensors
- IoT based Location Finder with Map Integration
- IoT based Electrical Applications (Demo) •
- Working with MQTT and Fire base •
- Linking MATLAB and Raspberry Pi •
- Data logging techniques using SQL •
- Working with IFTTT •
- Google Assistant Interface for Appliances Control •
- Interfacing with Alexa •
- Working with Firebase Cloud services •
- Working with Adafruit and Thingsboard servers •

REFERENCES:

- 1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"2014.
- 2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley Publications, 1st edition,2020.

e-RESOURCES:

- 1. https://nptel.ac.in > courses, "Internet of Things" Prof.Sudip Misra, IIT Kharagpur.
- 2. https://www.khanacademy.org/computing/computer-science/internet-intro/internet-works-intro/v/theinternet-packet-routers-and-reliability.

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TOTAL : 30 PERIODS

21BMV02BIOMEDICAL SIGNAL AND IMAGE PROCESSING USING NI
VISION AND BIOMEDICAL TOOLKITL T P C
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Prerequisite:

Knowledge of Signals, Systems and Processing methods of Images.

Preamble:

Biomedical Signal and Image Processing provides an introduction to the basic concepts of signal and Image processing methods and to acquire knowledge of analysis of systems using various transformation techniques. It provides students to realize and develop an algorithm using LabVIEW. This course gives an in-depth analysis of the origin and processing of bioelectrical signals and Images of humans. The analysis is related to differentiate healthy and pathological conditions and emerges from clinical situations and issues. **Course Outcomes:** Upon completion of the course, students will be able to:

1. Understand the concepts of Data Acquisition, Interfacing of Biomedical Sensors.

2. Cultivate the conceptual learning of analysis and processing of signals and images for Industrial Applications.

Module 1 – Graphical System Design - Data Acquisition & Signal processing

- Introduction to Graphical Systems Design using NI Technology
- Hands on LabVIEW Programming concepts
- Decision making Structures Loops Arrays Clusters Variables
- File I/O Operations.
- Introduction to Data Acquisition System
- Signal Conditioning for Data Acquisition
- Acquisition of Analog and Digital signals
- Introduction to Sensors & Signals
- Interfacing Biomedical Vernier Sensors
- Data Logging
- Biomedical Signal processing
- Analyzing Blood Pressure and ECG Feature Extraction.

Module 2 – Image processing using Graphical System Design

- Introduction to Image processing
- Introduction to Images & types of Images
- Memory Allocation & Memory Management of Image
- Introduction to offline Gray scale Image Processing
- Thresholding Images Cropping Images
- Pixel Processing Morphology Process for Binary Images
- Pattern Recognition Color Recognition Size Identification
- Particle Classification Particle Analysis
- Application development using Biomedical images

REFERENCES:

- 1. Sanjit K.Mitra, "Digital Signal Processing–A Computer Based Approach", Mc Graw Hill, 4thedition 2013.
- 2. Rafael C, Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education Asia, Fourth Edition, 2018.
- 3. Jovitha Jerome "Virtual Instrumentation using labview" Prentice Hall of India, NewDelhi, 2010.

e-RESOURCES:

1. http://www.ni.com/academic/students/learn-labview/

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TOTAL: 30 PERIODS

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21BMV03

Prerequisite:

Knowledge on Fundamentals of Images processing techniques and Python Programming Languages.

TRAINING ON MACHINE LEARNING

Preamble:

Training on Machine Learning is a complete practical approach for designing the smart devices using machine learning methodology. This course aims to Integration of Data Analytics along with the Machine Learning Algorithms.

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

- Implement machine learning algorithms on hardware's. 1.
- 2. Develop Bio-inspired evolutionary algorithms on Data Analytical Part

Module 1 – Introduction to Machine Learning

- Machine learning Approaches
- Design smart devices Mathematical Expressions/ Concepts/ Different types of Supervisory • and Un-supervisory Concepts.
- Introduction about the Python to machine learning- Introduction of Numpy/Pandas/Scikit ٠
- Data extraction Phases-Working on Data for the different field domains such as Cloud, • WSN, Medical(Using raspberry pi 3)
- Programming in Python is employed Working on the different Supervisory Machine learning algorithms based on above stated data.
- Validation of machine learning algorithms with following parameters such as Confusion • Matrix, n-Cross Validated Matrix, RoC validations, Matrix (Hands-on Working with RPI 3+Python along with the datas)

Module 2 – Applications of Machine Learning

- Hands -on With the following projects:
- WSN/Cloud Security, Smart Home Automation Product, •
- Medical Image Processing, •
- Project Demo of AI Learned Sticks on RPI-3, ٠
- Introduction of deep learning -Pytorch mechanism.

REFERENCES:

- 1. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, 2017.
- 2. Miroslav Kubat, "An Introduction to Machine Learning", SPRINGER, Second Edition, 2017.

e-RESOURCES:

- 1. https://swayam.gov.in/course/4178-spoken-tutorial-python-english, "Introduction to Python", Prof. Prabhu Ramachandran, IIT Bombay.
- 2. https://onlinecourses.nptel.ac.in/noc18 cs21, "Programming, Data Structures and Algorithms Using Python", Prof.Madhavan Mukund, IIT-Bombay.

TOTAL: 30 PERIODS

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