Kongunadu College of Engineering and Technology
(Autonomous)
Affiliated to Anna University, Chennai
B.E. Biomedical Engineering
Regulations: KNCET-UGR2020
Choice Based Credit System
I toVIII Semesters Curricula & Syllabi
(Applicable for the students Admitted from 2021-2022 onwards)

Semester I							
S.No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20EN101	Technical English-I	HSMC	3	0	0	3
2	20MA101	Mathematics-I	BSC	3	1	0	4
3	20PH101	Engineering Physics	BSC	3	0	0	3
4	20CY101	Engineering Chemistry	BSC	3	0	0	3
5	20GE101	Structured Programming Using C	ESC	3	0	0	3
6	20GE102	Engineering Graphics	ESC	2	0	2	3
7	20TA101*	தமிழர்மரபு/Heritageof Tamils	HSMC	1	0	0	1
Practicals							
8	20BS101L	Physics and Chemistry Laboratory	BSC	0	0	2	1
9	20GE103L	Structured Programming Using C Laboratory	ESC	0	0	2	1
10	20EEC101L	English for Effective Communication	EEC	0	0	2	1
			Total	**18**	**1**	**8**	**23**

Semester II							
S.No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20EN201	Technical English-II	HSMC	3	0	0	3
2	20MA201	Mathematics-II	BSC	3	1	0	4
3	20BM201	Medical Physics	PCC	3	0	0	3
4	20BM202	Fundamentals of Biochemistry	PCC	3	0	0	3
5	20EE201	Electric Circuit Analysis	ESC	3	0	0	3
6	20BS201	Environmental Science	HSMC	3	0	0	3
7	20TA201**	தமிழரும்தொழில்நுட்பமும்/Tamils and Technology	HSMC	1	0	0	1
Practicals							
8	20GE201L	Engineering Practices Laboratory	ESC	0	0	2	1
9	20BM203L	Biochemistry Laboratory	PCC	0	0	2	1
10	20EEC201L	Soft Skills	EEC	0	0	2	1
			Total	**19**	**1**	**6**	**23**

* - Exempted for 2021-22 admitted students & in Semester II for the 2022-23 admitted students
** - Exempted for 2021-22 admitted students & in Semester III for the 2022-23 admitted students

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Semester III							
S.No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20MA302	Transforms and Partial Differential Equations	BSC	3	1	0	4
2	20BM301	Anatomy and Human Physiology	PCC	3	0	0	3
3	20EC302	Digital Electronics	PCC	3	0	0	3
4	20EC303	Signals and Systems	PCC	3	1	0	4
5	20EC306	Electron Devices and Circuits	ESC	3	0	2	4
6	20IT302	C++ and Data Structures	ESC	3	0	0	3
Practicals							
7	20BM302L	Human Physiology Laboratory	PCC	0	0	2	1
8	20IT303L	C++ and Data Structures Laboratory	ESC	0	0	2	1
9	20EEC301L	Soft Skills Development	EEC	0	0	2	1
			Total	**18**	**2**	**8**	**24**

Semester IV							
S.No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20MA404	Probability and Statistics	BSC	3	1	0	4
2	20BM401	Pathology and Microbiology	PCC	3	0	0	3
3	20BM402	Sensors and Measurements	PCC	2	0	2	3
4	20EC402	Linear Integrated Circuits	PCC	3	0	0	3
5	20EC305	Analog and Digital Communication	PCC	3	0	0	3
6	20EE405	Basics of Electrical Engineering	ESC	3	0	0	3
7	20MC003	Constitution of India	MC	2	0	0	0
Practicals							
8	20BM403L	Pathology and Microbiology Laboratory	PCC	0	0	2	1
9	20EC407L	Integrated Electronics Laboratory	PCC	0	0	2	1
10	20EEC401L	Life Skills and Personality Development	EEC	0	0	2	1
			Total	**19**	**1**	**8**	**22**

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Semester V							
S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20BM501	BiocontrolSystems	PCC	3	0	0	3
2	20BM502	Biomedical Instrumentation	PCC	3	0	0	3
3	20EC504	Digital Signal Processing	PCC	3	0	2	4
4	20MC002	Universal Human Values 2: Understanding Harmony	MC	3	0	0	3
5		Professional Elective I	PEC	3	0	0	3
6		Open Elective I	OEC	3	0	0	3
Practicals							
7	20BM503L	Biomedical Instrumentation Laboratory	PCC	0	0	2	1
8	20BM504L	Mini Project-I	EEC	0	0	2	1
9	20EEC501L	Professional Skills Development	EEC	0	0	2	1
			Total	**18**	**0**	**8**	**22**

Semester VI							
S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20BM601	Diagnostic and Therapeutic Equipments	PCC	3	0	0	3
2	20BM602	Radiological Equipments	PCC	3	0	0	3
3	20BM603	Hospital Management	PCC	3	0	0	3
4	20EC502	Microprocessors and Microcontrollers	PCC	3	0	0	3
5		Professional Elective II	PEC	3	0	0	3
Practicals							
6	20EC505L	Microprocessors and Microcontrollers Laboratory	PCC	0	0	3	1
7	20BM604L	Diagnostic and Therapeutic Equipment Laboratory	PCC	0	0	3	1
8	20BM605L	Mini Project-II	EEC	0	0	2	1
9	20EEC601L	Employability Skills	EEC	0	0	2	1
			Total	**15**	**0**	**10**	**19**

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Semester VII							
S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1	20BM701	Digital Image Processing	PCC	3	0	0	3
2	20BM702	Rehabilitation Engineering	PCC	3	0	0	3
3		Professional Elective III	PEC	3	0	0	3
4		Professional Elective IV	PEC	3	0	0	3
5		Open Elective II	OEC	3	0	0	3
Practicals							
6	20BM703L	Digital Image Processing Laboratory	PCC	0	0	2	1
7	20BM704L	Hospital Training	EEC	0	0	2	1
			Total	**15**	**0**	**4**	**17**

Semester VIII							
S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
Theory							
1		Professional Elective V	PEC	3	0	0	3
2		Professional Elective VI	PEC	3	0	0	3
Practical							
6	20BM801L	Project Work	EEC	0	0	20	10
			Total	**6**	**0**	**20**	**16**

Total Credits: 166

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S. No	Vertical 1 Bio Engineering	Vertical 2 Medical Device Innovation and Development	Vertical 3 Healthcare Management	Vertical 4 Mechanics in Healthcare	Vertical 5 Signal and Image Processing	Vertical 6 Wearable Communication	Vertical 7 Advanced Healthcare Devices	Vertical 8 Diversified
1.	20BM502PE Biomaterials	20BM508PE Medical Device Design	20BM707PE Hospital Waste Management	20BM604PE Biomechanics	20BM709PE Biometric Systems	20BM706PE Virtual Reality and Augmented Reality	20BM501PE BioMEMS	20MA601PE Quantitative and Reasoning Aptitude
2.	20BM602PE Artificial Organs and Implants	20BM710PE Healthcare Product Development	20BM801PE Electrical Safety and Quality Assurance	20BM807PE Biomechanics of Joints And Orthopaedic Implants	20BM601PE Bio Signal Processing	20BM808PE Wearable Systems	20BM702PE Robotics in Medicine	20CS201 Python Programming
3.	20BM708PE Neural Engineering	20ME709PE Rapid Manufacturing	20BM714PE Forensic Science in Healthcare	20BM802PE Ergonomics	20BM811PE Pattern Recognition and Expert Systems in Medicine	20BM814PE Medical Informatics	20BM703PE Advanced Diagnostic and Therapeutic Equipment's	20BM704PE Soft Computing Methods for Biomedical
4.	20BM504PE Biophotonics	20BM609PE Medical Device Regulations	20BM715PE Economics and Management for Engineers	20BM701PE Physiological Modeling	20BM809PE Computational Methods for Signal and Image Processing	20BM705PE Telehealth Technology	20BM505PE Biomedical LASER Instruments	20CS401 Computer Networks
5.	20BM503PE Medical Optics	20BM610PE Medical Innovation and Entrepreneurship	20BM716PE Bio Statistics	20BM810PE Modeling and Designing of Bone and Dental Implants	20CS808PE Computer Vision	20BM815PE Body Area Networks	20BM816PE Critical Care Equipment	20BM818PE Embedded Systems and IoT
6.	20BM507PE Principles of Tissue Engineering	20BM804PE Machine Learning Techniques in Medicine	20BM717PE Clinical Engineering	20BM603PE Biofluids and Dynamics	20BM803PE Brain Computer Interface and its Applications	20EC706PE Introduction to Wireless and Cellular Communication	20BM817PE Human Assist Devices	20BM711PE Artificial Intelligence Search Methods for Problem Solving
7.	20BM506PE Genetic Engineering: Theory And Application	20BM805PE Medical Radiation Safety	20BM712PE Management Information System	20BM719PE Assistive Technology	20BM813PE Speech Processing	20BM812PE Modern Digital Communication Techniques	20EC809PE Enclosure Design of Electronics	
8.		20BM605PE Drug Delivery: Principles And Engineering	20BM713PE Organizational Behaviour	20BM606PE Computational Continuum Mechanics	20BM607PE Computational Neuroscience		20BM806PE Microelectronics: Devices to Circuits	

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Registration of Professional Elective Courses from Verticals:

- Professional Elective Courses will be registered in Semesters V to VIII. 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.
- The registration of courses for B.E./B.Tech (Honours) 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 (Honours) or Minor degree also.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: BIO ENGINEERING

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM502PE	Biomaterials	PEC	3	0	0	3
2	20BM602PE	Artificial Organs and Implants	PEC	3	0	0	3
3	20BM503PE	Medical Optics	PEC	3	0	0	3
4	20BM708PE	Neural Engineering	PEC	3	0	0	3
5	20BM504PE	Biophotonics	PEC	3	0	0	3
6	20BM507PE	Principles of Tissue Engineering	PEC	3	0	0	3
7	20BM506PE	Genetic Engineering: Theory And Application	PEC	3	0	0	3

VERTICAL 2: MEDICAL DEVICE INNOVATION AND DEVELOPMENT

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM508PE	Medical Device Design	PEC	3	0	0	3
2	20BM710PE	Healthcare Product Development	PEC	3	0	0	3
3	20ME709PE	Rapid Manufacturing	PEC	3	0	0	3
4	20BM609PE	Medical Device Regulations	PEC	3	0	0	3
5	20BM610PE	Medical Innovation and Entrepreneurship	PEC	3	0	0	3
6	20BM804PE	Machine Learning Techniques in Medicine	PEC	3	0	0	3
7	20BM805PE	Medical Radiation Safety	PEC	3	0	0	3
8	20BM605PE	Drug Delivery: Principles And Engineering	PEC	3	0	0	3

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VERTICAL 3: HEALTHCARE MANAGEMENT

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM707PE	Hospital Waste Management	PEC	3	0	0	3
2	20BM801PE	Electrical Safety and Quality Assurance	PEC	3	0	0	3
3	20BM714PE	Forensic Science in Healthcare	PEC	3	0	0	3
4	20BM715PE	Economics and Management for Engineers	PEC	3	0	0	3
5	20BM716PE	Bio Statistics	PEC	2	0	2	3
6	20BM717PE	Clinical Engineering	PEC	3	0	0	3
7	20BM712PE	Management Information System	PEC	3	0	0	3
8	20BM713PE	Organizational Behaviour	PEC	3	0	0	3

VERTICAL 4: MECHANICS IN HEALTHCARE

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM604PE	Biomechanics	PEC	3	0	0	3
2	20BM807PE	Biomechanics of Joints And Orthopaedic Implants	PEC	3	0	0	3
3	20BM802PE	Ergonomics	PEC	3	0	0	3
4	20BM701PE	Physiological Modeling	PEC	3	0	0	3
5	20BM810PE	Modeling and Designing of Bone and Dental Implants	PEC	3	0	0	3
6	20BM603PE	Biofluids and Dynamics	PEC	3	0	0	3
7	20BM719PE	Assistive Technology	PEC	3	0	0	3
8	20BM606PE	Computational Continuum Mechanics	PEC	3	0	0	3

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VERTICAL 5: SIGNAL AND IMAGE PROCESSING

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM709PE	Biometric Systems	PEC	3	0	0	3
2	20BM601PE	BioSignal Processing	PEC	3	0	0	3
3	20BM811PE	Pattern Recognition and Expert Systems in Medicine	PEC	3	0	0	3
4	20BM809PE	Computational Methods for Signal and Image Processing	PEC	3	0	0	3
5	20CS808PE	Computer Vision	PEC	2	0	2	3
6	20BM803PE	Brain Computer Interface and its Applications	PEC	3	0	0	3
7	20BM813PE	Speech Processing	PEC	3	0	0	3
8	20BM607PE	Computational Neuroscience	PEC	3	0	0	3

VERTICAL 6: WEARABLE COMMUNICATION

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM706PE	Virtual Reality and Augmented Reality	PEC	3	0	0	3
2	20BM808PE	Wearable Systems	PEC	3	0	0	3
3	20BM814PE	Medical Informatics	PEC	3	0	0	3
4	20BM705PE	Telehealth Technology	PEC	3	0	0	3
5	20BM815PE	Body Area Networks	PEC	3	0	0	3
6	20EC706PE	Introduction to Wireless and Cellular Communication	PEC	3	0	0	3
7	20BM812PE	Modern Digital Communication Techniques	PEC	3	0	0	3

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VERTICAL 7: ADVANCED HEALTHCARE DEVICES

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20BM501PE	BioMEMS	PEC	3	0	0	3
2	20BM702PE	Robotics in Medicine	PEC	3	0	0	3
3	20BM703PE	Advanced Diagnostic and Therapeutic Equipment's	PEC	3	0	0	3
4	20BM505PE	Biomedical LASER Instruments	PEC	3	0	0	3
5	20BM816PE	Critical Care Equipment	PEC	3	0	0	3
6	20BM817PE	Human Assist Devices	PEC	3	0	0	3
7	20BM806PE	Microelectronics: Devices to Circuits	PEC	3	0	0	3
8	20EC809PE	Enclosure Design of Electronics	PEC	3	0	0	3

VERTICAL 8: DIVERSIFIED

Sl No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20MA601PE	Quantitative and Reasoning Aptitude	PEC	3	0	0	3
2	20CS201	Python Programming	PEC	3	0	0	3
3	20BM704PE	Soft Computing Methods for Biomedical	PEC	3	0	0	3
4	20CS401	Computer Networks	PEC	3	0	0	3
5	20BM818PE	Embedded Systems and IoT	PEC	3	0	0	3
6	20BM711PE	Artificial Intelligence Search Methods for Problem Solving	PEC	3	0	0	3

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Open Electives

(Students shall choose the Open Elective Courses, such that the course contents are not similar to any other contents/title under other course categories)

Open Elective I (Semester- V)

S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20CE501PE	Industrial Waste Management	OEC	3	0	0	3
2	20CE502PE	Air Pollution and Control Engineering	OEC	3	0	0	3
3	20CS506OE	Fundamentals of Software Engineering	OEC	3	0	0	3
4	20CS507OE	Introduction to Data Structures and Algorithms	OEC	3	0	0	3
5	20EC501OE	Sensors and Transducers	OEC	3	0	0	3
6	20EC503PE	Internet of Things	OEC	3	0	0	3
7	20EE501OE	Non-Conventional Energy Resources	OEC	3	0	0	3
8	20EE502OE	Industrial Automation	OEC	3	0	0	3
9	20ME601OE	Production Technology	OEC	3	0	0	3
10	20ME602OE	Basics of Automotive Components	OEC	3	0	0	3
11	20IT501OE	Fundamentals of Operating Systems	OEC	3	0	0	3
12	20IT502OE	Introduction to Database	OEC	3	0	0	3

Open Elective II (Semester- VII)

S. No	Course Code	Course Title	Course Category	No of Hours/Week			Credit
				L	T	P	
1	20CE701OE	Environmental Impact Assessment	OEC	3	0	0	3
2	20CE702OE	Building Services	OEC	3	0	0	3
3	20CS706OE	E-Commerce	OEC	3	0	0	3
4	20CS708OE	Introduction to Computer Organization	OEC	3	0	0	3
5	20EC701OE	Consumer Electronics	OEC	3	0	0	3
6	20EC702OE	RFID and Flexible Sensors	OEC	3	0	0	3
7	20EE701OE	Energy Storage Systems	OEC	3	0	0	3
8	20EE702OE	Electrical Safety Engineering	OEC	3	0	0	3
9	20ME701OE	Basics of Hydraulic and Pneumatic Systems	OEC	3	0	0	3
10	20ME702OE	Alternative Energy Fuels	OEC	3	0	0	3
11	20IT701OE	Programming in JAVA	OEC	3	0	0	3
12	20IT702OE	Web Design	OEC	3	0	0	3

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SUMMARY

S.No	Course Category	Credits As Per Semester								Total Credit	Percentage (%)
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	7							11	6.63
2	BSC	11	4	4	4					23	13.86
3	ESC	7	4	8	3					22	13.25
4	PCC		7	11	14	11	14	7		64	38.55
5	PEC					3	3	6	6	18	10.84
6	OEC					3		3		6	3.61
7	EEC	1	1	1	1	2	2	1	10	19	11.45
8	MC					3				3	1.81
Total		23	23	24	22	22	19	17	16	166	100

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ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

- A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.
- For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.
- For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Vertical I Fintech and Block Chain	**Vertical II** Entrepreneurship	**Vertical III** Public Administration	**Vertical IV** Business Data Analytics	**Vertical V** Environment and Sustainability
20M101 - Financial Management	20M201 - Foundations of Entrepreneurship	20M301 - Principles of Public Administration	20M401 - Statistics for Management	20M501 - Sustainable infrastructure Development
20M102 - Fundamentals of Investment	20M202 - Team Building and Leadership Management for Business	20M302 - Elements of public Administration	20M402 - Data mining for Business Intelligence	20M502 - Sustainable Agriculture and Environmental Management
20M103 - Banking, Financial Services and Insurance	20M203 -Creativity and Innovation in Entrepreneurship	20M303 -Public Personnel Administration	20M403 - Human Resource Analytics	20M503 - Sustainable Bio Materials
20M104 - Introduction to Blockchain and its Applications	20M204 - Principles of Marketing Management for Business	20M304 - Administrative Theories	20M404 - Marketing and Social Media Web Analytics	20M504 - Materials for Energy Sustainability
20M105 - Fintech Personal Finance and Payments	20M205 - Human Resource Management for Entrepreneurs	20M305 -Indian Administrative System	20M405 - Operation and Supply Chain Analytics	20M505 - Green Technology
20M106 - Introduction to Fintech	20M206 - Financing New Business Ventures	20M306 - Public Policy Administration	20M406 - Financial Analytics	20M506 - Environmental Quality Monitoring and Analysis
-	-	-	-	20M507 - Integrated Energy Planning for Sustainable Development
-	-	-	-	20M508 - Energy Efficiency for Sustainable Development

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(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL I: FINTECH AND BLOCK CHAIN

S. No.	Course Code	Course Title	Course Category	No. of Hours/Week			Credit
				L	T	P	
1	20M101	Financial Management	PEC	3	0	0	3
2	20M102	Fundamentals of Investment	PEC	3	0	0	3
3	20M103	Banking, Financial Services and Insurance	PEC	3	0	0	3
4	20M104	Introduction to Blockchain and its Applications	PEC	3	0	0	3
5	20M105	Fintech Personal Finance and Payments	PEC	3	0	0	3
6	20M106	Introduction to Fintech	PEC	3	0	0	3

VERTICAL II: ENTREPRENEURSHIP

S. No.	Course Code	Course Title	Course Category	No. of Hours/Week			Credit
				L	T	P	
1	20M201	Foundations of Entrepreneurship	PEC	3	0	0	3
2	20M202	Team Building and Leadership Management for Business	PEC	3	0	0	3
3	20M203	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3
4	20M204	Principles of Marketing Management for Business	PEC	3	0	0	3
5	20M205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3
6	20M206	Financing New Business Ventures	PEC	3	0	0	3

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VERTICAL III: PUBLIC ADMINISTRATION

S. No.	Course Code	Course Title	Course Category	No. of Hours/Week			Credit
				L	T	P	
1	20M301	Principles of Public Administration	PEC	3	0	0	3
2	20M302	Elements of public Administration	PEC	3	0	0	3
3	20M303	Public Personnel Administration	PEC	3	0	0	3
4	20M304	Administrative Theories	PEC	3	0	0	3
5	20M305	Indian Administrative System	PEC	3	0	0	3
6	20M306	Public Policy Administration	PEC	3	0	0	3

VERTICAL IV: BUSINESS DATA ANALYTICS

S. No.	Course Code	Course Title	Course Category	No. of Hours/Week			Credit
				L	T	P	
1	20M401	Statistics for Management	PEC	3	0	0	3
2	20M402	Data mining for Business Intelligence	PEC	3	0	0	3
3	20M403	Human Resource Analytics	PEC	3	0	0	3
4	20M404	Marketing and Social Media Web Analytics	PEC	3	0	0	3
5	20M405	Operation and Supply Chain Analytics	PEC	3	0	0	3
6	20M406	Financial Analytics	PEC	3	0	0	3

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VERTICAL V: ENVIRONMENT AND SUSTAINABILITY

S. No.	Course Code	Course Title	Course Category	No. of Hours/Week			Credit
				L	T	P	
1	20M501	Sustainable infrastructure Development	PEC	3	0	0	3
2	20M502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3
3	20M503	Sustainable Bio Materials	PEC	3	0	0	3
4	20M504	Materials for Energy Sustainability	PEC	3	0	0	3
5	20M505	Green Technology	PEC	3	0	0	3
6	20M506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3
7	20M507	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3
8	20M508	Energy Efficiency for Sustainable Development	PEC	3	0	0	3

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27/11/22

20EN101 **TECHNICAL ENGLISH-I**

(Common to all branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to,

- Enable learners develop basic communication skills in English.
- Enhance the speaking skills for academic, professional and social purposes.
- Enable learners make use of the electronic media such as internet and other online resources for their language development.
- Inculcate the habit of reading and writing for the purpose of effective communication.
- Develop confidence in learners to communicate in English for all purposes.

UNIT I SHARING INFORMATION **9**

Listening: Intensive and Extensive Listening, Barriers to Effective Listening; Speaking: Descriptions, Reading: Skimming and Scanning, Writing: Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.), Grammar: Parts of speech, Vocabulary: Word formation.

UNIT II INTRODUCTION TO WRITING **9**

Listening: Listening lectures/talks, Speaking: Telephonic interview, Reading: Inferring inferential and contextual meaning from literary texts, Writing: Biographical writing - Writing a paragraph (Cause and Effect/Compare and Contrast/Narrative/Analytical) - Writing a set of recommendations – Writing a set of instructions, Grammar: Prepositions - Active and Passive voice - Present Tense, Vocabulary: Confused Words.

UNIT III IMPROVING SPEAKING **9**

Listening: Listening to talks by eminent personalities - Focused audio tracks, Speaking: Role Play - Simulation - Group Interaction, Reading: Reading magazines, Writing: Business Letter (Order/Acceptance), Grammar: Past tense - Tag Questions - Subject - Verb Agreement, Vocabulary: Learning Words in Situations.

UNIT IV READING SKILLS **9**

Listening: Techniques for Effective Listening, Speaking: Speaking in job Interviews, Reading: Reading for factual and inferential meaning, Writing: Interpreting Visual Materials (Line Graphs, Pie Charts etc.), Grammar: Adverbs - Future Tense, Vocabulary: Single word substitutes.

UNIT V PRONUNCIATION **9**

Listening: Understanding different Accents, Listening to Radio and TV and taking notes, Speaking: Giving impromptu talks- Making presentations, Reading: Practice in speed reading, Writing: Business Letter (enquiry/Rejection), Grammar: Direct and Indirect Speech, Vocabulary: Phrasal Verbs.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Use suitable vocabulary with confidence and express their ideas both in speech and writing.
- Write intelligibly avoiding grammatical errors, using a range of vocabulary, organizing their ideas logically on a topic.
- Speak confidently, with one or many listeners using appropriate communicative strategies.
- Read different genres of texts adopting various reading strategies.
- Understand different spoken discourses/excerpts in different accents.

Text Book:

1. Sanjay Kumar and Pushp Lata, "Communication Skills", Oxford University Press, 2nd edition, 2015.

References:

1. P Kiranmai and Rajeevan Geeta, "Basic Communication Skills", Foundation Books, revised edition, 2013.
2. Redston, Chris & Gillies Cunningham, "Face2Face (Pre-Intermediate Student's Book & Workbook",Cambridge University Press, New Delhi, 2nd edition,2005.
3. Perumal, Lakshmana.N and Sathiseelan S, "Technical English-I", Sri Krishna Hitech Publishing Company Pvt.Ltd, Chennai: 2014.
4. Mohan, Krishna and Banerji Meera, "Developing Communication Skills", Macmillan Publishers India Ltd., Delhi, 2nd edition,2009.
5. Hewings, Martin. "Advanced English Grammar: A self study reference and Practice book for advanced South Asian students" Cambridge University Press, New Delhi, revised edition, 1999.

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20MA101	MATHEMATICS-I (COMMON TO ALL BRANCHES)	L T P C 3 1 0 4

OBJECTIVES:

The Student should be made to:

- Develop the use of matrix algebra technique for practical application
- Apply the properties of arithmetic and geometric in sequences and series
- Familiarize the students with differential calculus
- Familiarize the student with functions of several variables, this is needed in many branches of engineering
- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage

UNIT I MATRICES **12**

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

UNIT II SEQUENCE AND SERIES **12**

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III DIFFERENTIAL CALCULUS **12**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules – Maxima and Minima of functions of one variable – Local maximum and minimum – absolute minimum and absolute maximum – increasing and decreasing – Concavity and inflection points – Rolle's theorem and mean value theorem(excluding proofs).

UNIT IV FUNCTIONS OF SEVERAL VARIABLES **12**

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS **12**

Double integrals in Cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Triple integrals – Volume of Solids: Volume as triple integral – Cylindrical coordinates – Spherical coordinates

TOTAL: 60 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Eigen values and eigenvectors, Diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices
- Determining and describing the nth term of arithmetic and geometric sequences
- Apply differential calculus tools in solving various application problems
- Apply differentiation to solve maxima and minima problems
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables

TEXT BOOKS:

1. Grewal B S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2014.
2. Narayanan S and Manicavachagom Pillay T K, "Calculus", Volume I and II, S Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Dass H K and Er. Rajnish Verma, "Higher Engineering Mathematics", S Chand Private Ltd., 2011.
2. Bali N P and Manish Goyal, "A Text Book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Peter V O'Neil, "Advanced Engineering Mathematics", Cengage Learning, 7th Edition, 2012.
4. Veerarajan T, "Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

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20PH101	ENGINEERING PHYSICS (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Describe the basics of crystal structures and their growth techniques
- Explain the elastic properties of materials
- Analyze heat transfer mechanisms and their applications
- Develop an understanding of quantum mechanical concepts and their applications
- Gain fundamental knowledge of laser action, their production and fiber optics

UNIT – I CRYSTAL PHYSICS **9**

Crystalline and Amorphous materials – Crystal systems, Bravais lattices, Miller indices – Interplanar distance – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal growth techniques – solution, Melt (Bridgman and Czochralski methods)

UNIT – II PROPERTIES OF MATTER **9**

Elasticity – Stress–Strain diagram and its uses – Factors affecting elastic modulus – Twisting couple – Torsion pendulum: Theory and Experiment – Bending of beams – Bending moment – Cantilever: Theory and Experiment – Uniform and Non–Uniform bending: Theory and Experiment I–shaped girders and its application.

UNIT – III THERMAL PHYSICS **9**

Modes of heat transfer – Thermal capacity – Newton's law of cooling – Rectilinear heat flow – Thermal conductivity – Forbe's and Lee's disc method: Theory and Experiment – Radial flow of heat – Thermal conductivity of rubber tube – Heat conduction through compound media (Series and Parallel) – Solar power – Advantages – Solar water heater.

UNIT – IV QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's Law from Planck's theory – de-Broglie wavelength – Properties of Matter waves – Schrodinger's wave equation – Time independent and time dependent wave equations – Physical significance of wave function – Particle in a one dimensional box – Extension to 3D – Degeneracy – Electron Microscope – Scanning Electron Microscope.

UNIT – V LASER AND FIBER OPTICS **9**

Lasers: Principles of laser – Population inversion – Einstein's A and B coefficients–derivation – Modes of vibration in CO_2 molecules – CO_2 Laser – Nd–YAG Laser – Basic principles of a homojunction semiconductor Laser – Industrial and Medical applications of Laser – Fiber optics: principle, numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode) – Fiber optic communication system (Block diagram).

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Identify crystal structure types and describe their growth techniques
- Analyze the elastic properties of materials
- Evaluate the thermal properties of materials
- Explain basic quantum mechanical concepts and their applications
- Elucidate the basic concepts of lasers and their applications

TEXT BOOKS:

1. Pandey B K and Chaturvedi S, "Engineering Physics", Cengage Learning India Pvt. Ltd., Delhi, 2018.
2. Malik H K and Singh AK, "Engineering Physics" TMH, New Delhi, 2010.

REFERENCES:

1. Gaur R K and Gupta S L, "Engineering Physics", DhanpatRai Publications, New Delhi, 2014.
2. Marikani A, "Engineering Physics", PHI learning Pvt. Ltd. New Delhi, Second Edition, 2013.
3. Avadhanulu M N, "Engineering Physics", SChand and Company Ltd, New Delhi, First Edition, 2007.
4. Wahab M A, "Solid State Physics", Narosa Publishing House, New Delhi, 2nd Edition, 2005.

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BoS(S&H)

20CY101	ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the characteristics of water & to know the various treatment methods for effective applications.
- Understand the concept of electrochemistry and corrosion prevention.
- Know the significance and properties of polymers.
- Know the fundamentals of phase rule and its applications and to analyse the principle and generation of energy in batteries and fuel cells.
- Evaluate types of fuels based on calorific values and to know the significance of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY **9**

Sources of water – Hard and soft water – Boiler feed water-requirements – disadvantages of using hard water in boilers (Scale- Sludge- Caustic Embrittlement - Priming - Foaming) – Estimation of hardness of water by EDTA method – Internal conditioning (Phosphate, Calgon, Colloidal and Carbonate conditioning methods) – External conditioning – Zeolite and demineralization process – desalination and reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION **9**

Electrochemistry – Nernst equation and its Applications – Electrochemical series – Corrosion – Types – Dry and Wet corrosion – Galvanic corrosion – Differential aeration corrosion – Pitting corrosion – Corrosion control – sacrificial anodic method and impressed current cathodic protection method – Protective coatings – Paints and its constituents.

UNIT III POLYMERS **9**

Polymers – definition – Classification – addition – condensation polymerization and copolymerization – mechanism of polymerization – (cationic, Anionic and free Radical) – Plastics – classification – preparation, properties and uses of PVC, Teflon, Nylon-6,6 and Epoxy resin – Rubber – vulcanization of rubber – butyl rubber, Styrene Butadiene Rubber.

UNIT IV PHASE RULE AND STORAGE DEVICES **9**

Phase Rule – Terms involved – One Component system (water system) – Two component system (Lead-Silver system) – Thermal analysis – Storage devices – Cell and a battery – Alkaline battery – Lead acid battery – Nickel-Cadmium battery and lithium battery – Fuel cells – Hydrogen – Oxygen fuel cell.

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UNIT V FUELS AND COMBUSTION **9**

Fuels – Introduction – Classification of fuels – coal – Analysis of coal (proximate and ultimate) – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Manufacture of synthetic petrol (Bergius process) – Knocking – Anti knocking – Octane number – Cetane number – Gaseous fuels – LPG, CNG – Combustion: Calorific value – higher and lower calorific values – Theoritical calculation of calorific value – Flue gas analysis (ORSAT Method).

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain knowledge on the water quality parameters.
- Identify the solutions to prevent corrosion.
- Analyse the applications of polymers.
- Achieve the knowledge about types of phase diagram and storage devices.
- Evaluate the characteristics of various fuels.

TEXT BOOKS:

1. Jain P C and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing, Company. New Delhi, 2013.
2. Dara S S, "A Text Book of Engineering Chemistry", S Chand & Co Ltd., New Delhi, 2013.

REFERENCES:

1. Shika Agarwal, "Engineering Chemistry", Cambridge University Press., Delhi, 2015.
2. Sivasankar B, "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Palanna O G, "Engineering Chemistry" ,Tata Mc.Graw Hill Education Private Limited, New Delhi, 2011
4. Prasanta Rath, "Engineering Chemistry", Cengage Learning India Pvt. Ltd., Delhi, 2018.

CHAIRMAN
BoS (S&H)

20GE101	STRUCTURED PROGRAMMING USING C (COMMON TO ALL BRANCHES)	L	T	P	C
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OBJECTIVES:

The student should be made to:

- Know the fundamentals of Computer and Programming
- Choose appropriate programming constructs in C language
- Construct programs using array and pointer
- Write programs using string and function
- Develop programs using the concept of structure, union and files

UNIT I FUNDAMENTALS OF COMPUTER AND PROGRAMMING 9

Computer System – CPU – Memory Unit – Data Representation – Number System and Conversion – Programming Fundamentals – Program Development Life Cycle – Algorithm – Control Structures – Flowchart – Pseudocode – Programming Paradigms – Problem Formulation and Problem Solving.

UNIT II BASICS OF C PROGRAMMING 9

Overview of C – C Character Set – Identifiers and Keywords – Declaration – Data types – Type Qualifiers and Type Modifiers – Variables and Constants – Structure of a C Program – Executing a C Program – Operators and Expressions – Decision-Making and Looping Statements.

UNIT III ARRAYS AND POINTERS 8

Introduction to Arrays – Single Dimensional Arrays – Multidimensional Array – Pointers – void Pointer – Null Pointer – Relationship between Arrays and Pointers – Arrays of Pointers – Pointer to a Pointer – Pointer to an Array.

UNIT IV STRINGS AND FUNCTIONS 9

Strings – Character Arrays – Reading String input – String Library Functions – List of Strings – Command Line Arguments – Functions: Types – Declaration – Definition – Function Call – Pass by Value – Pass by Reference – Passing arrays to functions – Recursion – Pointer to function.

UNIT V STRUCTURE, UNION AND FILES 10

Structures – Pointers to Structures – Array of Structures – Structures within a Structure – Functions and Structures – typedef and Structures – Unions – Practical Applications of Unions – Enumerations – Bit fields – Storage Classes – C Preprocessor – Files: Streams – File type – File operations – Command line arguments.

TOTAL: 45 PERIODS

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BoS(IT)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the fundamentals of Computer and Programming
- Choose appropriate data types, variables and statements for solving simple problems
- Construct programs using arrays and pointers for a given scenario
- Write programs using strings and functions
- Develop programs using structure, union and files for a given scenario

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Pearson India Education Services Pvt. Ltd., 2016.

REFERENCES:

1. Ajay Mital, "Programming in C - A Practical Approach", Pearson Education, 2015.
2. Dromey R G, "How to Solve it by Computer", Pearson Education, Fifteenth Impression, 2014.
3. Herbert Schildt, "C - The Complete Reference", Tata McGraw-Hill, 2013
4. Ashok N Kamthane, "Computer Programming", Pearson Education, Second Edition, 2012.
5. Juneja B L and Anita Seth, "Programming in C", Cengage Learning India Pvt. Ltd., 2011

CHAIRMAN
BoS(IT)

20GE102	ENGINEERING GRAPHICS (COMMON TO ALL BRANCHES)	L T P C 2 0 2 3

OBJECTIVES:

The Student should be made to:

- Explain the students with various concepts like dimensioning, standards, curves and free hand sketching
- Impart knowledge on projection of points, lines and plane surfaces
- Improve the visualization skills for better understanding of projection of solids
- Develop the imaginative skills of the students required to understand section of solids and development of surfaces
- Make the students to understand the viewing perception of a solid object in Isometric and Perspective projections

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) **2**

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

UNIT I PLANE CURVES AND FREE HAND SKETCHING **9+6**

Curves used in engineering practices: Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, epicycloid – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views – Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **9+6**

Projection of points – Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true length and true inclination by rotating line method – Projection of planes inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **7+6**

Projection of simple solids like prisms, pyramids, cylinder, cone when the axis is inclined to one of the principal planes by rotating object method.

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UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **9+6**

Sectioning of solids: prisms, pyramids, cylinder, cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids: prisms, pyramids, cylinder and cone.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **9+6**

Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids: Prisms, pyramids, cylinder, cone – Perspective projection of simple solids: Prisms, pyramids and cylinder by visual ray method.

TOTAL: 75 (45+30) PERIODS

COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply the concepts of dimensioning, standards, curves and free hand sketching objects
- Sketch the projection of points, straight lines and plane surfaces
- Understand the projection of solids in various positions
- Construct projection of solids and development of surfaces
- Draw isometric and perspective sections of simple solids

TEXT BOOKS:

1. Natarajan K V, "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International Pvt. Limited, 2015.

REFERENCES:

1. Bhatt N D and Panchal V M, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C M, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K R, "Engineering Drawing", Vol. I and II Combined, Subhas Stores, Bangalore, 2007.

Special points applicable to End Semester Examinations on Engineering Graphics:

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

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20TA101 தமிழர் மரபு L T P C
(அனைத்து துறைகளுக்கும் பொதுவானது) 1 0 0 1

பாடத்தின் நோக்கங்கள்:

மாணவர்கள் கண்டிப்பாக அறிய வேண்டுவன

- மொழி மற்றும் இலக்கியங்களை மதிப்பிடுதல்
- பாறை மற்றும் நவீன ஓவியங்களை பகுப்பாய்தல்
- நாட்டுப்புற மற்றும் தற்காப்பு கலைகளை புரிந்து கொள்ளுதல்
- திணையில் தமிழர்களின் கருத்தை பயன்படுத்துதல்
- இந்திய கலாச்சாரத்தில் தமிழர்களின் பங்கினை நினைவு கூறுதல்

அலகு 1 மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விளக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மை கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் - பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2 மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை –சிற்பக்கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு 3 நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு 4 தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிற பகுதிகளில் தமிழ் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

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பாடத்தின் முடிவுகள்:

பாடத்தின் முடிவில், மாணவர்கள் அறிந்து கொள்வன

- மொழி மற்றும் இலக்கியங்களைப் பற்றி அறிந்து கொள்கிறார்கள்
- பாறை மற்றும் நவீன ஓவியங்களை பற்றிய அறிவுகளை கற்கின்றனர்
- நாட்டுப்புற மற்றும் தற்காப்பு கலைகளை வளர்க்க முடிகிறது
- தினைக் கூறும் கருத்துக்களை அறிய முடிகிறது
- நமது இந்திய கலாச்சாரத்தை புரிந்து கொள்ள முடிகிறது

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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Mech

20TA101	HERITAGE OF TAMILS (Common to all branches)	L T P C 1 0 0 1

Course Objectives:

Students should be made to

- Evaluate classical language and literature
- Analyze rock art paintings to modern art
- Understand folk and martial arts
- Apply the concept of thinai in Tamils
- Remembering the concept of Tamils to Indian culture

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry – Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam,Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

Chairman
BoS/S&H

Course Outcomes:

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

- Know the classical language and literature
- Gain knowledge about rock art paintings and modern arts
- Develop folk and martial arts
- Learn concept of Thinai
- Understand our Indian culture

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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20BS101L	PHYSICS AND CHEMISTRY LABORATORY (COMMON TO ALL BRANCHES)	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Understand the characteristics of an engineering material
- Know the physical properties of matter
- Estimate types of ions in drinking water
- Analyze the characteristics of acids
- Know the conductivity of a solution

LIST OF THE EXPERIMENTS - PHYSICS - Any six experiments to be conducted

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method.
9. Determination of Coefficient of Viscosity of liquids by Poiseuille's method.

LIST OF THE EXPERIMENTS - CHEMISTRY – Any seven experiments to be conducted

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of chloride content of water sample by Argentometric method.
4. Determination of strength of given hydrochloric acid using pH meter.
5. Determination of strength of acids in a mixture of acids using conductivity meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Conductometric titration of strong acid Vs strong base.
8. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
9. Estimation of iron content of the water sample using spectrophotometer.
10. Determination of rate of corrosion by weight loss method.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Analyze the characteristics of engineering materials.
- Find out the physical properties of matter.
- Assess the water quality parameter.
- Analyze the pH of aqueous solutions.
- Gain knowledge on chemical properties of liquids.

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BoS (S&H)

20GE103L	STRUCTURED PROGRAMMING USING C LABORATORY (COMMON TO ALL BRANCHES)	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Develop C programs using conditional and looping statements
- Understand the concept of functions, arrays and strings
- Learn to access memory using pointers
- Group different kinds of information related to a single entity
- Understand the manipulation of data in permanent storage

PRACTICAL SYLLABUS:

1. Programs using decision making statements.
2. Programs using looping statements.
3. Programs using user defined functions and recursive functions.
4. Programs using one dimensional and two dimensional arrays.
5. Solving problems using string functions.
6. Programs using pointers and dynamic memory allocation.
7. Programs using structures and unions.
8. Programs using pointers to structures and other data types.
9. Programs using text files.
10. Programs using binary files.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Implement C programs using control statements
- Write C programs using functions, arrays and strings
- Access data in memory using pointers
- Use structures and other user defined data structures to manipulate heterogeneous data
- Manipulate data stored on permanent storage

CHAIRMAN
BoS(IT)

20EEC101L	ENGLISH FOR EFFECTIVE COMMUNICATION (COMMON TO ALL BRANCHES)	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Develop and understand verbal and non-verbal communication
- Acquire grammar for effective communication
- Enable learners express different functions using appropriate language
- Enable learners develop their ability to converse in different situations
- Impart skills in using English at workplace effectively

UNIT I UNDERSTANDING COMMUNICATION **6**

Role and Importance of Communication – Verbal and Non-verbal Communication – Barriers to Communication – Communication Mediums – Effective Communication – Group Communication.

UNIT II VOCABULARY AND GRAMMAR **6**

Aspects of vocabulary learning – Word formation – Sentence formation - Short forms of verbs - Common Grammatical Errors – Connective sentences - usage of Idioms and Phrases.

UNIT III EXPRESSING VARIED FUNCTION **6**

Introducing yourself – Greeting – Conversation between stranger – permission – opinion – information – Refusing – Agree/disagree – Apology – Praising – Requesting.

UNIT IV CONVERSATION LANGUAGE **6**

Understanding conversation – Chunking –Telling a story – Understanding public speech – Recognize Instructions – Persuasive Speech –Introduction to emphatic stress – Intensifying important words – Emphasizing corrections.

UNIT V CORPORATE COMMUNICATION **6**

Listening to Videos – Telephone and Email Etiquette – Extempore – Drafting and Delivering a Speech – Making Presentations – Group Discussion.

TOTAL: 30 PERIODS

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BoS (S&H)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Create a group and discuss efficiently in a group communication
- Understand the Sentence formation with proper Vocabulary
- Sort out the language functions to foster a good conversation
- Get the proper pronunciation and usage of language
- Build Communication at workplace in various situations

REFERENCES:

1. Hancock Mark, "English Pronunciation in Use: Intermediate", Cambridge University Press, New Delhi, 2009.
2. Cheepen Christine and James Monaghan, "Spoken English: A Practical Guide", London: Pinter, 1990.
3. Sasikumar V and Dhamija P V, "Spoken English-A Self-Learning Guide to Conversation Practice", TMH, 1995.
4. Singh Ashish, "How to Communicate Effectively", Patridge, New Delhi, 2014.
5. Wilkinson Andrew M, "Spoken English", Edgbaston: University of Birmingham, 1966.

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BoS (S&H)

BME
27/1/22

20EN201 **TECHNICAL ENGLISH -II**

(Common to all branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The students should be made to

- Improve the reading skills for the purpose of effective communication.
- Make learners acquire listening and speaking skills in both formal and informal contexts.
- Enable learners improve their reading skills from online sources.
- Equip the learners with writing skills needed for academic as well as work place.
- Help the learners improve language skills at their own pace by using the language lab.

UNIT I CONVERSATIONS **9**

Listening: Barriers to Effective Listening- Listening to informal conversations, Speaking: Short conversations in varied situations in student life, Reading: Reading Short text and longer passages for comprehension at deeper levels, Writing: Writing reviews (book / film), Grammar: Compound Nouns - Numerical Expression, Vocabulary: Homonyms-Homophones.

UNIT II INFORMAL USE OF LANGUAGE **9**

Listening: Listening to Situation based Dialogues, Speaking: Using dictionary for learning pronunciation, stress, and syllable divisions. Reading: Reading a short story for appreciation and understanding, Writing: Informal Letter writing- Dialogue writing Grammar: Definition - Purpose expressions- Relative Pronouns, Vocabulary: Technical Vocabulary - Count/Un count nouns.

UNIT III GENERAL READING **9**

Listening: Listening strategies for deeper understanding, Speaking: Asking about Routine actions and giving directions, Reading: an article from Newspaper- Critical reading, Writing: Minutes of meeting - Essay writing, Grammar: Degrees of Comparison, Vocabulary: Collocations.

UNIT IV ENGLISH FOR CAREER **9**

Listening: Listening strategies for Effective conversation, Speaking: Group Discussion skills, Reading: pre reading and post reading tasks, Writing: Applying for a Job - Cover Letter -Resume preparation, Grammar: Articles, Vocabulary: Synonyms and Antonyms.

UNIT V REPORT WRITING **9**

Listening: Listening and making notes, Speaking: Discussion on problems and solutions, Reading: Reading Journal Articles, Writing: Types of Reports - Feasibility / Accident /Project Report, Grammar: If Clause, Vocabulary: Idioms and their Meanings.

TOTAL: 45 PERIODS

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BoS/S&H

OUTCOMES:

On successful completion of this course, the students will be able to,

- Speak fluently, express their opinions clearly, initiate a discussion, negotiate, and argue using appropriate communicative strategies.
- Listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.
- Read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation.
- Make effective presentations using power point and participate successfully in Group Discussions.
- Write efficiently and persuasively and create different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.

Text Book:

1. Bhatnagar, Nitin and Bhatnagar, Mamta, "Communicative English for Engineering and Professionals", Pearson Education India, 1st edition, 2010.

References:

1. Raman Meenakshi and Sharma Sangeetha, "Technical Communication Principles and Practice", Oxford University Press: New Delhi, 3rd edition, 2015.
2. Andrea J, Rutherfoord, "Basic Communication Skills for Technology" Pearson Education, Inc., 2nd edition, 2000.
3. Rizvi M, Ashraf. "Effective Technical Communication "Tata McGraw Hill Education Pvt.Ltd., NewDelhi,11th edition, 2001.
4. Perumal, Lakshmana N and Sathiseelan S, "Technical English-II", Sri Krishna Hitech Publishing Company Pvt.Ltd, Chennai, 2014.

Chairman
BoS/S&H

20MA201	MATHEMATICS-II (COMMON TO ALL BRANCHES)	L T P C 3 1 0 4

OBJECTIVES:

The student should be made to:

- Make the student acquire sound knowledge of techniques in solving ordinary differential equations obtained from engineering problems
- Acquaint the student with the concepts of vector calculus that is needed for problems in engineering disciplines
- Understand the Analytic Functions can be widely used for modelling the various laws of physics
- Familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- Make the student for appreciating the purpose of using transforms to create a new domain in which it is earlier to handle the problem that is being investigated

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients $(e^{ax}V, x^nV)$ – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS 12

Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration: line integral – surface integral – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs)

UNIT III ANALYTIC FUNCTIONS 12

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 – Conformal mapping $(w = z^2, z + k, 1/z, kz)$ and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

UNIT V LAPLACE TRANSFORM 12

Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and final value theorems – Transform of periodic functions – Inverse transforms – Convolution theorem – Solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

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BoS (S&H)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply various methods of solving differential equation which arise in many application problems
- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals
- Examine analytic functions and its properties, conformal mapping and its applications
- Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem
- Use knowledge of Laplace transform and its properties, inverse Laplace transform to solve linear differential equations

TEXT BOOKS:

1. Grewal B S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2014.
2. Bali N P and Manish Goyal, "A Text Book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.

REFERENCES:

1. Dass H K and Er. Rajnish Verma, "Higher Engineering Mathematics", S Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 3rd Edition, 2012.
3. Jain R K and Iyengar S R K, "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Veerarajan T, "Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

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BoS (S&H)

20BM201	MEDICAL PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Differentiate between ionizing and non-ionizing radiation with its medical applications
- Understand the Principles of Radioactive nuclides and its use in Medicine
- Appreciate the interaction of Radiation with Lipids and study its associated effects
- Know the Dose and Exposure limits of human with the advantages and disadvantages
- Enunciate the fundamentals of Acoustic waves and their interaction with human tissues.

UNIT I NON IONIZING RADIATION & ITS MEDICAL APPLICATION 9

Non-ionizing Electromagnetic Radiation: Overview of non-ionizing radiation effects – Low Frequency Effects – Higher frequency effects. Physics of light, Measurement of light and its unit – Limits of vision and color vision an overview, Thermography – Application.

UNIT II PRINCIPLES OF RADIOACTIVE NUCLIDES 9

Radioactive Decay – Spontaneous Fission – 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 III INTERACTION OF RADIATION WITH MATTER LIPIDS 9

Interaction of charged particles with matter – Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of Gamma radiation with matter – Photoelectric effect, Compton Scattering, Pair production, Attenuation of Gamma Radiation.

UNIT IV RADIATION DOSE AND ITS EFFECTS 9

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

UNIT V PRINCIPLES AND APPLICATIONS OF SOUND IN MEDICINE 9

Principles 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.

TOTAL: 45 PERIODS

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BoS (BME)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the difference between ionizing and non-ionizing radiation with its medical applications
- Describe the Principles of Radioactive nuclides and its usage in Medicine
- Analyze the interaction of Radiation with Lipids and its associated effects
- Appraise the Dose and Exposure limits of human with the advantages and disadvantages
- Address the fundamentals of Acoustic waves and their interaction with human tissues.

TEXT BOOKS:

1. Brown B H, Smallwood R H, Barber D C, Lawford P V and Hose D R "Medical Physics and Biomedical Engineering", Institute of Physics Publishing, Bristol and Philadelphia, 1999.
2. Gopal B Saha, "Physics and Radiobiology of Nuclear Medicine", Third Edition Springer, 2006.

REFERENCES:

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

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BoS (BME)

27/1/22

20BM202	FUNDAMENTALS OF BIOCHEMISTRY	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Gain Knowledge on the biochemical properties of biological system.
- Study about structural and functional properties of carbohydrates and its metabolism
- Understand biological classification, features of lipids and its metabolic disorders.
- Emphasize the basic properties, types and metabolic role of nucleic acid and protein bio molecules.
- Impart the knowledge about enzyme and its kinetic properties.

UNIT I INTRODUCTION TO BIOCHEMISTRY 9

Introduction to Biochemistry, water as a biological solvent, weak acid and bases, pH, buffers, Handerson – Hasselbalch equation, Physiological buffers in living systems, Energy in living organism, Properties of water and their applications in biological systems, Introduction to Biomolecules, Biological membrane, Clinical application of Electrolytes and radioisotopes.

UNIT II CARBOHYDRATES 9

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

UNIT III LIPIDS 9

Classification of lipids – simple, compound and derived lipids. Nomenclature of fatty acid, physical and chemical properties of fat. Metabolic pathways: synthesis and degradation of fatty acid (beta oxidation), hormonal regulation of fatty acid metabolism, ketogenesis, Biosynthesis of Cholesterol. Disorders of lipid metabolism.

UNIT IV NUCLEIC ACID & PROTEIN 9

Structure of purines and pyrimidines, nucleoside, nucleotide, DNA act as a genetic material, Chargaffs rules. Watson and crick model of DNA. Structure of RNA and its type Disorder of purines and pyrimidines nucleotide Classification, structure and properties of proteins, structural organization of proteins, classification and properties of amino acids. Separation of protein, Inborn Metabolic error of amino acid metabolism.

UNIT V ENZYME AND ITS CLINICAL APPLICATION 9

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

TOTAL: 45 PERIODS

Chairman
BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the basic principle and application of electrolytes, water and buffers in biological system.
- Explain the classification, structure, physical/chemical properties and metabolic pathways of carbohydrates and their functions
- Interpret the classification, properties and central metabolic pathway of lipids and its regulation
- Demonstrate the structure, classification and functions of amino acids and proteins
- Explore the role of enzymes and co-enzymes, mechanism of enzyme actions, factors influencing it and enzyme inhibition.

TEXT BOOK:

1. RAFI MD "Text book of Biochemistry for Medical Student" Second Edition, University Press, 2014.
2. David.W.Martin, Peter.A.Mayes , Victor. W.Rodwell, "Harper's Review of Biochemistry", LANGE Medical Publications, 1981.
3. Satyanarayana. U, Chakrapani. U, "Biochemistry", ELSEVIER, Fourth Edition-2014.

REFERENCE BOOK:

1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Pamela. C. Champe & Richard. A. Harvey, "Lippincott Biochemistry Lippincott's Illustrated Reviews", Raven publishers,1994
3. Trevor Palmer, "Understanding Enzymes", fourth Edition, Ellis Horwood Ltd., 1994.

Chairman
BoS/BME

20EE201	ELECTRIC CIRCUIT ANALYSIS (COMMON TO BME, ECE AND EEE)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Solve AC and DC circuit using network reduction technique
- Impart knowledge on solving circuit using network theorems
- Introduce the phenomenon of resonance in coupled circuits
- Understand about the two port networks and parameters
- Develop the transient response of various AC and DC circuits

UNIT I BASIC CIRCUITS ANALYSIS 9

Electrical Quantities - Network elements – R, L, C parameters - Energy sources - Ohm's law - Kirchhoff's laws - Power in series circuits - Resistors in series - Resistors in parallel - Mesh and Nodal analysis for AC and DC circuits.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS 9

Network reduction: Voltage and current division, source transformation and star delta conversion. Thevenin's and Norton'stheorems – Superposition theorem – Maximum power transfer theorem - Millman'stheorem - Tellegan'stheorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Resonance: Series and parallel resonance – Resonant frequency of tank circuit – Quality factor and Bandwidth – Coupled circuits: Self and mutual inductance – Coefficient of coupling – Tuned circuits: Single tuned circuits - Analysis of magnetic circuits - Composite series and parallel magnetic circuits.

UNIT IV TWO PORT NETWORKS 9

Two port networks - Z parameters - Y parameters - Transmission parameters - Hybrid (h) parameters – Inverse hybrid (g) parameters - Inter relationships of different parameters - Interconnection of two port network - Symmetrical properties of T and π networks - Lattice networks.

UNIT V TRANSIENT RESPONSE ANALYSIS 9

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and AC sinusoidal input - Introduction to Laplace transform for step, impulse and periodic functions.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the fundamentals of electric circuits
- Apply various theorems for the analysis of DC and AC circuits
- Understand the concept of resonant, tuned and coupled circuits
- Interpret the concepts of two port networks
- Obtain the transient response of electrical circuits

TEXT BOOK:

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", 5th Edition, McGraw Hill, 2015.

REFERENCES:

1. Chakrabarti A, "Circuit Theory (Analysis and synthesis), Revised Edition, DhanpatRaiand Sons, New Delhi, 2017.
2. Cunningham D R and Stuller J A, "Basic circuit Analysis", 3rdEdition, Jaiho publishing house, New Delhi, 2005.
3. Charles A Desoer and Ernest S Kuh, "Basic Circuit Theory", McGraw Hill, 2015.

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20BS201	ENVIRONMENTAL SCIENCE (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the interrelationship between living organism and environment
- Understand and tackle the impacts of pollution.
- Attain sustainable development by conserving natural resources.
- Find and implement scientific, technological, economic and political solutions to environmental problems
- Analyze the problems faced by the over population.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – concept of an ecosystem – structure and function of an ecosystem – Ecological succession – food chain – food web – structure and function of the (a) forest ecosystem (b) desert ecosystem (c) aquatic ecosystem – (pond and ocean) – Biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Endangered, Extinct and Endemic species – conservation of biodiversity: In-situ and ex-situ methods.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards- solid waste Management – role of an individual in prevention of pollution – disaster management: floods, earthquake, cyclone and landslides.

UNIT III NATURAL RESOURCES 9

Forest resources: deforestation – mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water – dams-benefits and problems – Mineral resources: environmental effects of extracting and using mineral resources – Food resources: World food problems – Effects of modern agriculture – fertilizer-pesticide problems, water logging, salinity – Energy resources: renewable and non-renewable energy sources (Solar, wind, Coal, Petrol, Nuclear) Land resource: land degradation, Soil erosion and desertification – role of an individual in conservation of natural resources.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

Sustainable development – Water conservation – rain water harvesting – resettlement and rehabilitation of people; its problems and concerns – environmental ethics – global warming – acid rain , ozone layer depletion – wasteland reclamation – consumerism – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – Role of NGO's in environmental protection.

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UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Acquire knowledge on public awareness & about the environment & ecosystem.
- Able to identify the impacts of pollution.
- Frame solutions to achieve sustainable development.
- Able to analyze about the social issues in the environment.
- Apply the acquired knowledge to tackle the problems of over population.

TEXT BOOKS:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd., 2nd Edition, 2004.

REFERENCES:

1. Tyler Miller G and Scott Spoolman, "Introduction to Environmental Science", Cengage Learning India Pvt., Ltd., 2009.
2. Dharmendra S Sengar, "Environmental Law", Prentice hall of India Pvt Ltd, New Delhi, 2007.

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20TA201	தமிழரும் தொழில்நுட்பமும் (அனைத்து துறைகளுக்கும் பொதுவானது)	L T P C 1 0 0 1

பாடத்தின் நோக்கம்

மாணவர்கள் கண்டிப்பாக அறிய வேண்டுவன

- நெசவு மற்றும் பீங்கான் தொழில்நுட்பம் பற்றிய அறிவைப் பெறுதல்
- வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பத்தை உருவாக்குதல்
- உற்பத்தி தொழில்நுட்பத்தை பகுப்பாய்வு செய்தல்
- விவசாயம் மற்றும் நீர்ப்பாசனத் தொழில்நுட்பத்தைப் பயன்படுத்துதல்
- அறிவியல் மற்றும் அறிவியல் தமிழ் மற்றும் தமிழ் கணிப்பொறியை நினைவுபடுத்துதல்

அலகு 1 நெசவு மற்றும் பானை தொழில் நுட்பம் 3

சங்க காலத்தில் நெசவுத்தொழில் – பானை தொழில் நுட்பம் – கருப்பு, சிவப்பு பாண்டங்கள் – பாண்டுகளில் கீறல் குறியீடுகள்.

அலகு 2 வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுக்கல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் நாயக்கர் கால கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக்கலை.

அலகு 3 உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்பு தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடிகள் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்பு துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பம் 3

அணை, குளங்கள், மதகு – சோழர்கால குமுளி தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்து குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5 அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

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பாடத்தின் முடிவுகள்:

பாடத்தின் முடிவில், மாணவர்கள் அறிந்து கொள்வன

- பீங்கான் மற்றும் நெசவு தொழில்நுட்பத்தை புரிந்துகொள்வது
- புதிய வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பத்தை உருவாக்குதல்
- உற்பத்தித் தொழில்நுட்பத்தை அடையாளம் காணுதல்
- விவசாயம் மற்றும் நீர்ப்பாசனம் பற்றிய புரிதல்
- அறிவியல் தமிழ் மற்றும் தமிழ் கணினி பற்றிய அறிவு

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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20TA201	TAMILS AND TECHNOLOGY (Common to all branches)	L T P C 1 0 0 1

Course Objectives:

Students should be made to

- Gain knowledge about weaving and ceramic technology
- Creating a design and construction technology
- Analyzing manufacturing technology
- Applying agriculture and irrigation technology
- Remembering scientific and scientific Tamil and Tamil computing

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo -Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing Knowledge of Sea - Fisheries– Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

Course Outcomes:

At the end of the Course, Students will be able to

- Understand weaving under ceramic technology
- Develop new design and construction technology
- Identify the manufacturing technology
- Understand agriculture and irrigation
- Knowledge of scientific Tamil and Tamil computing

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TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை– (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு).
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of the river Vaigai' (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
10. Studies in the History of India with Special Reference to Tamilnadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamilnadu Textbook and Educational Services Corporation, Tamilnadu.)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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20GE201L	ENGINEERING PRACTICES LABORATORY (COMMON TO ALL BRANCHES)	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Access the areas of knowledge in application criteria's for plumbing, carpentry through practical manner
- Develop the engineering basis work in welding, machining and sheet metal works
- Make the specified skills in foundry, smithy and fitting operations
- Study the various basic domestic wiring circuits and measure the electrical parameters
- Impart the knowledge of basic electronic components and assemble simple electronic circuits in printed circuit boards

GROUP A (CIVIL AND MECHANICAL)

I. CIVIL ENGINEERING PRACTICE **5**

1. Buildings
   (a) Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects.
2. Plumbing Works
   (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
   (b) Study of pipe connections requirements for pumps and turbines.
   (c) Preparation of plumbing line sketches for water supply and sewage works.
   (d) Hands-on-exercise:
      (i) Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
      (ii) Demonstration of plumbing requirements of high-rise buildings.
3. Carpentry using Power Tools only
   (a) Study of the joints in roofs, doors, windows and furniture.
   (b) Hands-on-exercise: Wood work, joints by sawing, planning and cutting.

II. MECHANICAL ENGINEERING PRACTICE **10**

1. Welding:
   (a) Arc Welding
      (i) Butt joints.
      (ii) Lap joints.
      (iii) T-joints.
   (b) Gas welding practice.
2. Basic Machining
   (a) Simple Turning, Facing.
   (b) Drilling Practice.
3. Sheet Metal Work
   (a) Model making-Cylinder, Funnel and Tray.
   (b) Different type of joints.

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4. Machine assembly practice:
   (a) Study of Centrifugal pump
   (b) Study of Air conditioner
5. Demonstration on:
   (a) Smithy operations, upsetting, swaging, setting down and bending.
   Example: Exercise – Production of hexagonal headed bolt.
   (b) Foundry operations like mould preparation for gear and step cone pulley.
   (c) Fitting – Exercises – Preparation of square fitting and V-fitting models.

GROUP B (ELECTRICAL AND ELECTRONICS)

III. ELECTRICAL ENGINEERING PRACTICE **10**

1. a) Residential house wiring using switches, fuse, indicator, lamp and Energy meter.
   b) Study of different type of electrical wiring joints systems.
   c) Stair case wiring.
2. Industrial wiring using switches, fuse, indicator and Energy meter.
3. Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.
4. Measurement of energy using single phase energy meter.
5. Measurement of earth resistance using Megger.
6. Assembling of ceiling fan.

IV. ELECTRONICS ENGINEERING PRACTICE **5**

1. Study of Electronic components and equipments – Resistor colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, NOT, NAND and NOR.
3. Soldering practice - Components Devices and Circuits - Using general purpose PCB.
4. Design of HWR and FWR.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply the tasks of work in plumbing and carpentry in application areas regard to pipeline joints, household fittings, water supply and sewage works, joints in roofs, doors, windows and furniture
- Analyze the engineering knowledge through welding, sheet metal forming, bending and basic machining operations
- Understand the assembly works on study of pump, Air conditioner and demonstration works on Smithy, foundry and fitting operation
- Understand the basic domestic wiring circuits and measure the various electrical parameters
- Analyse the basic concept of digital circuits and assemble electronic circuits

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20BM203L	BIOCHEMISTRY LABORATORY	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Estimate and quantify the Biomolecules present in the sample
- Conduct tests for Carbohydrates, Proteins and Lipids
- Prepare Serum and Plasma from blood
- Separate the Macromolecules present in the sample
- Estimate and interpret various biochemical parameters

LIST OF EXPERIMENTS:

1. General guidelines for working and functional component of biochemistry lab
2. Preparation of solutions: 1) Percentage solutions, 2) Molar solutions, 3) Normal solutions
3. Standardization of pH meter, Preparation of buffers
4. General tests for Carbohydrates, Proteins and Lipids.
5. Working principle of Centrifuge.
6. Identification of Blood collection Tubes
7. Preparation of Serum and Plasma from blood.
8. Estimation of Blood Glucose
9. Estimation of Creatinine
10. Estimation of Urea
11. Estimation of Uric acid
12. Estimation of Cholesterol
13. Assay of SGOT/SGPT
14. Separation of proteins by SDS electrophoresis (Demo)
15. Separation of amino acids by thin layer chromatography (Demo)

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the Biochemistry laboratory functional components
- Demonstrate the basic principles of preparation of buffers
- Exhibit the separation of Serum and Plasma from blood
- Determine various Biochemical parameters and their interpretations from the Blood sample.
- Reveal the separation technology of Proteins and Amino Acids.

CHAIRMAN
BoS (BME)

20EEC201L	SOFT SKILLS (COMMON TO ALL BRANCHES)	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Develop in learners a deep sense of self- esteem
- Enhance learners' self-motivation
- Impart leadership skills
- Help learners enhance critical, creative and analytical skills
- Felicitate learners acquire problem solving skills

UNIT I IDENTITY CONSTRUCTION 6

Identity formation – Theories of moral Development(Kohlberg) – Cultural heritage – Physical appearance – Problem of Identity Correspondence –Self acceptance– Knowing oneself – Self-confidence –Positive thinking – Self-development – Perception, attitude and Behavioural change, Personality development – Self-esteem.

UNIT II MOTIVATION AND MORALE 6

Definition – types (Intrinsic and Extrinsic) – Theories (Maslow's hierarchical needs) – Factors that affect motivation – Motivational strategies – Motivational plan – Interruption and Distractions – Motivation in the Business World.

UNIT III PROFESSIONAL THEORIES 6

Communication – Functions of leadership – Work pressure handling – Creative and critical thinking – Career planning and management – Emotional intelligence – Time management – Negotiation – Conflict management

UNIT IV APPLICATION SKILLS 6

Visionary thinking – formulating strategies – shaping strategies – building organizations relationships – change management – Project Management Skills – Independent working skills - Writing skills – Public Speaking –Analytical skills – Neo Research and Development.

UNIT V PROBLEM SOLVING SKILLS 6

Problem solving approaches and its components – Teamwork – Innovative and creative thinking– Tools and Techniques – Application of SMART analysis – Adaptability and flexibility– Decision making.

TOTAL: 30 PERIODS

CHAIRMAN
BoS(S&H)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Know the detail information of individuals
- Increase the self-confidence and develop the moral identity
- Accumulate the learner's career building skills
- Improve professional and life skills
- Engage the imagination to explore new possibilities, Formulate and articulate ideas.

REFERENCES:

1. Covey Sean, "Seven Habits of Highly Effective Teens", New York, Fireside Publishers, 1998.
2. Thomas A Harris, "I am Ok, You Are Ok", Harper and Row,New York, 1972.
3. Daniel Coleman, "Emotional Intelligence", Bantam Book, 2006.

CHAIRMAN
BoS(S&H)

BME 27/1/22

20MA302 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to AGE, BME, CIVIL, ECE, EEE & MECH) **L T P C**

3 1 0 4

OBJECTIVES:

The student should be made to,

- Introduce the basic concepts of PDE for solving standard partial differential equations.
- Introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- Acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- Acquaint the student with Fourier transform techniques used in wide variety of situations.
- Introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations –Singular integrals -Solutions of standard types of first order partial differential equations -Lagrange's linear equation -Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Dirichlet's conditions –General Fourier series –Odd and even functions –Half range sine series –Half range cosine series –Complex form of Fourier series –Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE –Method of separation of variables -Fourier Series Solutions of one dimensional wave equation –One dimensional equation of heat conduction –Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem –Fourier transform pair –Fourier sine and cosine transforms –Properties –Transforms of simple functions –Convolution theorem –Parseval's identity.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms -Elementary properties –Inverse Z-transform (using partial fraction and residues) –Initial and final value theorems -Convolution theorem -Formation of difference equations–Solution of difference equations using Z-transform.

TOTAL: 60 PERIODS

Chairman
BoS/S&H

OUTCOMES:

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

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

Text Books:

1. Grewal B S, "Higher Engineering Mathematics",Khanna Publishers, New Delhi, 43rd edition, 2014.
2. Narayanan S,Manicavachagom Pillay T K and Ramanaiah G, "Advanced Mathematics for Engineering Students", S Viswanathan Publishers Pvt. Ltd, Chennai, Vol. II & III, 1998.

References:

1. Bali N P and Manish Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications Pvt. Ltd, 9th edition, 2014.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ",John Wiley, India, 10th edition, 2016.
3. James G, "Advanced Modern Engineering Mathematics", Pearson Education, 3rd edition, 2007.
4. Ramana B V, "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 11th edition, 2015.
5. Wylie R C and Barrett L C, "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, New Delhi, 6th edition, 2012.

Chairman
BoS/S&H

20BM301 **ANATOMY AND HUMAN PHYSIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

The Student should be made to:

- Identify all the organelles of an animal cell and their function.
- Understand the structure and functions of the skeletal, muscular and respiratory systems of human body.
- Gain knowledge on the structural and functional aspects of cardiovascular and lymphatic systems of human body.
- Learn the anatomical characteristics of nervous system and sensory organs.
- Empower the physiological importance of digestive and urinary system.

UNIT I CELL AND TISSUE STRUCTURE **9**

Structure of Cell: Structure and functions of sub organelles – Cell Membrane – Transport across cell membrane – Action potential – Cell division. Types of Specialized tissues – Functions.

UNIT II SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS **9**

Skeletal: Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. Muscular: Parts of Muscle – Movements. Respiratory: Parts of Respiratory systems – Types of Respiration – Mechanisms of Breathing – Regulation of Respiration.

UNIT III CARDIOVASCULAR AND LYMPHATIC SYSTEMS **9**

Cardiovascular: Components of Blood and functions – Blood Groups and importance – Structure of Heart – Conducting systems of Heart – Properties of Cardiac Muscle – Cardiac Cycle – Heart Beat – Regulation of Heart rate and Blood pressure. Lymphatic: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels.

UNIT IV NERVOUS SYSTEMS AND SENSE ORGANS **9**

Nervous: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal cord – Tract and Pathways of Spines – Reflex Mechanism – Classification of Nerves – Autonomic Nervous systems and its functions. Sense Organs: Eye and Ear.

UNIT V DIGESTIVE AND URINARY SYSTEMS **9**

Digestive: Organs of Digestive system – Digestion and Absorption. Urinary: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary system – Urinary reflex.

TOTAL: 45 PERIODS

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Chairman
BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the basic structure and functions of cell.
- Elucidate the physiology of skeletal, muscular and respiratory systems of human body.
- Give explanation about the interconnection of nervous systems in human.
- Discuss the importance of cardiovascular and lymphatic systems.
- Analyze the structural and functional aspects of digestive and urinary system.

TEXT BOOKS:

1. Prabhjot Kaur. "Text Book of Anatomy and Physiology", Lotus Publishers, 2014
2. Elaine N Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi, 2007.

REFERENCES:

1. Frederic H Martini, Judi L Nath, Edwin F Bartholomew, "Fundamentals of Anatomy and Physiology", Pearson Publishers, 2014.
2. Gillian Pocock, Christopher D Richards, "The Human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 2013.
3. William F Ganong, "Review of Medical Physiology", 22nd Edition, McGraw Hill, New Delhi, 2010.
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W B Saunders Company, 2015.
5. Guyton and Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 2015.

Chairman
BoS/BME

20EC302	DIGITAL ELECTRONICS (COMMON TO BME, ECE AND EEE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the Digital fundamentals, Boolean algebra, Logic circuit minimization techniques and its applications in digital systems
- Construct various combinational digital circuits using logic gates
- Analyzethe design procedures for synchronous sequential circuits with flipflop elements
- Analyzethe design procedures for asynchronous sequential circuits
- Learn various semiconductor memories and related technology

UNIT I DIGITAL FUNDAMENTALS **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, radix conversion, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems and Postulates, Logic gates – Universal gates – Sum of products and product of sums – Minterms and Maxterms – Karnaugh Map Minimization.

UNIT II COMBINATIONAL CIRCUIT DESIGN **9**

Design of Half and Full Adders, Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Binary Multiplier, Multiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Parity Checker and Generator, Introduction to HDL – HDL Models of Combinational circuits.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Latches, Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters – Ripple Counters, Synchronous Counter, Ring Counters, Shift registers, Universal Shift Register. HDL Models of Sequential Circuits.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS **9**

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

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS **9**

Basic memory structure – ROM – PROM – EPROM – EEPROM – EAPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL. Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics – RTL, TTL, ECL, CMOS.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (ECE)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Know about Digital logic fundamentals and minimization of logic circuits
- Design various combinational digital circuits using logic gates
- Examine various synchronous sequential circuits
- Design various asynchronous sequential circuits
- Understand semiconductor memories and related technology with Programmable Logic devices

TEXT BOOKS:

1. Morris Mano M and Michael D Ciletti, "Digital Design", Pearson, 6th Edition, 2018.

REFERENCES :

1. Charles H Roth, "Fundamentals of Logic Design", Thomson Learning, 6th Edition, 2013.
2. Thomas L Floyd, "Digital Fundamentals", Pearson Education Inc, 10th Edition, 2011
3. Salivahanan S and Arivazhagan S, "Digital Electronics", Vikas Publishing House Pvt Ltd, 1st Edition, 2012.
4. Anil K Maini, "Digital Electronics", Wiley, 2014.
5. Anand Kumar A, "Fundamentals of Digital Circuits", PHI Learning Private Limited, 4th Edition, 2016.
6. Soumitra Kumar Mandal, "Digital Electronics", McGraw Hill Education Private Limited, 2016.

CHAIRMAN
BoS (ECE)

20EC303	SIGNALS AND SYSTEMS (Common to BME & ECE)	L T P C 3 1 0 4

OBJECTIVES:

The student should be made to:

- Understand the basic properties of signals and systems
- Learn the methods of characterization of Laplace transform and Fourier Transform
- Analyze LTI Continuous time systems using Laplace Transform
- Study the methods of characterization of Z transform and Fourier Transform
- Analyze LTI Discrete time systems using Z-Transform

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

Introduction to Signals and Systems – Continuous Time(CT) Signals – Discrete Time(DT) Signals – Standard Signals: Impulse, Step, Ramp, Exponential and Sinusoidal Signals – Basic operations on Signals: Amplitude Scaling, Signal Addition, Signal Multiplication, Time Shifting, Time Reversal and Time Scaling - Classification of CT and DT signals: Deterministic and Random, Periodic and Aperiodic, Even and Odd, Energy and Power, Causal and Non Causal – Classification of CT and DT systems: Static and Dynamic, Time Invariant and Time Variant, Linear and Nonlinear, Causal and Non Causal, Stable and Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 12

Introduction to Fourier series – Dirichlet's conditions – Trigonometric form of Fourier series – Laplace Transform – Region of Convergence (ROC) – Properties of Laplace Transform – Inverse Laplace Transform using Partial Fraction Expansion method – Continuous Time Fourier Transform(CTFT) – Properties of CTFT – Relation between Laplace transform and CTFT.

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12

Impulse Response: Causality and Stability of LTI CT systems – Convolution Integral using Analytical method – Solution of Differential equations using Laplace Transform – Analysis of LTI Continuous Time systems using Laplace Transform: Transfer function, Impulse response, Step response and Output response – Block diagram representation: Direct form-I, Direct form-II, Cascade and Parallel forms.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12

Sampling Theorem – Aliasing – Z-Transform – Region of Convergence (ROC) – Properties of Z-Transform – Inverse Z-Transform using Partial Fraction Expansion and Power Series Expansion method-Discrete Time Fourier Transform (DTFT) – Properties of DTFT – Relation between Z-Transform and DTFT.

UNIT V LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS 12

Impulse Response: Causality and Stability of LTI DT systems – Convolution Sum using Analytical, Graphical and Tabulation method – Solution of Difference equations using Z-Transform – Analysis of LTI Discrete Time systems using Z-Transform: Transfer function, Impulse response, Step response and Output response – Block diagram representation: Direct form-I, Direct form-II, Cascade and Parallel forms.

TOTAL: 60 PERIODS

CHAIRMAN
BoS (ECE)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Classify and Identify the types of signals and systems based on their properties
- Apply Fourier series, Laplace transform and Fourier transform for CT signals
- Design the LTI CT systems using Laplace Transform and realize its structure
- Apply Z-Transform and Fourier transform for DT signals
- Solve the LTI DT systems using Z-Transform and realize its structure

TEXT BOOKS:

1. Nagoor Kani A, "Signals and Systems(Simplified)", Tata Mc Graw Hill, 2016.

REFERENCES :

1. Allan V Oppenheim, Alan S Wilsky and Hamid Nawab S, "Signals and Systems", Pearson, Second Edition, 2019.
2. Lathi B P, "Principles of Linear Systems and Signals", Oxford, Second Edition, 2009.
3. Anand Kumar A, "Signals and Systems", Prentice Hall India, Third Edition, 2013.
4. Palani S, "Signals and Systems", Ane's Book Pvt. Ltd., First Edition, 2009.
5. Zeimer R E, Tranter W H and Fannin R D, "Signals and Systems - Continuous and Discrete", Pearson, 2015.

CHAIRMAN
BoS (ECE)

20EC306 **ELECTRON DEVICES AND CIRCUITS** **L T P C**
3 0 2 4

OBJECTIVES:

The students will be made to:

- Understand the structure and characteristics of various diodes
- Study the fundamentals of transistors and FETs
- Learn about the various Power devices and Display devices
- Acquire familiarity in the rectifiers, Filters and Oscillators
- Explore the characteristics of amplifier gain and frequency response

UNIT I DIODES **9**

PN junction diode, Zener diode , Schottky barrier diode- -Varactor diode LASER diode –Tunnel diode, -Forward and reverse bias characteristics, Applications.

UNIT II TRANSISTORS **9**

NPN - PNP – Operations - Current equations – Input and Output characteristics of CE, CB, CC, JFETs – Drain and Transfer characteristics – MOSFET Characteristics, D-MOSFET, E-MOSFET- Characteristics

UNIT III POWER DEVICES AND DISPLAY DEVICES **9**

UJT, SCR, DIAC, TRIAC, Power BJT- Power MOSFET- DMOS-VMOS, LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD, LDR

UNIT IV RECTIFIER, FILTER AND OSCILLATORS **9**

Rectifiers – Half Wave and Full Wave Rectifier, Filters, Regulated Power Supply – Switching Power Supplies, Oscillators: Colpitts oscillator, Hartley oscillator and Wien bridge oscillator

UNIT V AMPLIFIERS **9**

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

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode
2. Zener diode Characterisitcs and Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. FET Characteristics
5. SCR Characteristics
6. Half Wave and Full Wave Rectifier
7. Verification of KVL and KCL
8. Verification of Thevenin, Superposition and Maximum Power transfer theorems

PRACTICALS: 30 PERIODS

TOTAL: 75 PERIODS

Chairman
BoS/ECE

23/4/23

OUTCOMES:

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

- Explain the structure, working and characteristics of various diodes
- Analyze the operation and characteristics of different transistors
- Identify and differentiate various power switches and display devices for real-time applications
- Choose and adapt the required rectifiers, filters and oscillators for amplifier design
- Design the amplifiers with required gain and frequency response

TEXT BOOKS:

1. David A. Bell, "Electronic devices and circuits", Oxford University higher education. 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits", Oxford University Press,7th Edition, 2017.

REFERECES:

1. Thomas L Floyd, "Electronic Devices", Pearson presntice hall, 10th Edition, 2017.
2. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
3. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 2002pearson India Education, 11th Edition, 2015.
4. Robert B Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

Chairman
BoS/ECE

20IT302	C++ AND DATA STRUCTURES (FOR BME& ECE DEPARTMENT ONLY)	L 3	T 0	P 0	C 3

OBJECTIVES:

The student should be made to:

- Understand the fundamentals of object oriented programming in C++
- Gain knowledge in object oriented programming concepts
- Be familiar with the advanced features of C++ programming language
- Learn the various algorithms of nonlinear data structures
- Acquire the knowledge in different algorithms for graph implementation

UNIT I OBJECT ORIENTED PROGRAMMING FUNDAMENTALS 9

C++ Programming features – Data Abstraction – Encapsulation – Class – Object – Constructors – Static members – Constant members – Member functions – Pointers – References – Role of this pointer – Storage classes – Function as arguments.

UNIT II OBJECT ORIENTED PROGRAMMING CONCEPTS 9

String Handling – Copy Constructor – Polymorphism – Compile time and run time polymorphisms – Function overloading – Operators overloading – Dynamic memory allocation – Nested classes – Inheritance – Virtual functions.

UNIT III C++ PROGRAMMING ADVANCED FEATURES 9

Abstract class – Exception handling – Standard libraries – Generic Programming – Templates – Class template – Function template – STL – Containers – Iterators – Function adaptors – Allocators – Parameterizing the class – File handling concepts.

UNIT IV ADVANCED NON-LINEAR DATA STRUCTURES 9

AVL trees – B-Trees – Red-Black trees – Splay trees – Binomial Heaps – Fibonacci Heaps – Disjoint Sets – Amortized Analysis – Accounting method – Potential method – Aggregate analysis.

UNIT V GRAPHS 9

Representation of Graphs – Breadth-first search – Depth-first search – Topological sort – Minimum Spanning Trees – Kruskal and Prim algorithm – Shortest path algorithm – Dijkstra's algorithm – Bellman-Ford algorithm – Floyd-Warshall algorithm.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (IT)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the concept of object oriented programming in C++
- Develop solutions for real-world problems using OOP concepts
- Utilize the features of templates, exception and file handling mechanisms
- Analysis the algorithms of nonlinear data structures
- Describe the different algorithms for graph implementation

TEXT BOOKS:

1. Bjarne Stroustrup, "The C++ Programming Language", Pearson Education, 4th Edition, 2013.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 4th Edition, 2013.

REFERENCES:

1. Balagurusamy E, "Object Oriented Programming with C++", Tata McGraw Education Hill, 8th Edition, 2020.
2. Ashok N Kamthane, "Object oriented Programming with ANSI and Turbo C++", Pearson India, 1st Edition, 2006.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", McGraw Hill, 3rd Edition, 2009.
4. Michael T Goodrich, Roberto Tamassia and David Mount, "Data Structures and Algorithms in C++", Wiley Publishers, 7th Edition, 2004.

CHAIRMAN
BoS (IT)

20BM302L	HUMAN PHYSIOLOGY LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

The student should be made to:

- Estimate and quantify blood cells
- Learn methods for identification of Blood groups
- Appreciate the difference between Bleeding time and Clotting time
- Estimate Haematological parameters
- Learn and analyze visual and hearing test.

LIST OF EXPERIMENTS

1. Study on Blood Samples Collection
2. Identification of Blood groups (Forward and Reverse) and Rh factors
3. Bleeding and Clotting time
4. Estimation of Haemoglobin by Shalish method
5. Total RBC count analysis
6. Total WBC count analysis
7. Differential count of Blood cells
8. Estimation of ESR
9. PCV, MCH, MCV, MCHC
10. Study on Hearing test – Tuning fork
11. Visual Activity – Snellen's Chart and Jaeger's Chart

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Identify and enumerate blood cells
- Enumeration of haematological parameters
- Analyze special sensory organs test
- Demonstrate about Bleeding and Clotting time
- Estimate the amount of Hb in human blood.

CHAIRMAN
BoS (BME)

20IT303L	C++ AND DATA STRUCTURES LABORATORY (COMMON TO ECE AND BME)	L T P C 0 0 2 1

OBJECTIVES:

The Student should be made to:

- Get a clear understanding of C++ concepts.
- Understand the object oriented programming in C++.
- Understand the mechanism of file handling and templates
- Implement the different data structures
- Develop the applications using different data structures

LIST OF EXPERIMENTS:

1. Basic Programs for C++ Concepts.
2. Develop the classes for understanding objects, member functions & constructors
    - Classes with primitive data members,
    - Classes with arrays as data members
    - Classes with pointers as data members
    - Classes with constant data members
    - Classes with static member functions
3. Write a C++ code to implement the polymorphism.
4. Write a C++ code to implement the file handling.
5. Array implementation of List Abstract Data Type (ADT)
6. Linked list implementation of List ADT
7. Stack ADT - Array and linked list implementations
8. Queue ADT – Array and linked list implementations
9. Search Tree ADT - Binary Search Tree
10. Graph Traversal

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this laboratory course, the students will be able to,

- Create simple programs in C++ programming language.
- Develop applications using object oriented programming concepts in C++.
- Utilize the concept of file handling and templates in application development.
- Implement the data structures concepts using C++.
- Design and implement C++ programs for manipulating trees and graphs.

CHAIRMAN
BoS (IT)

20EEC301L	SOFT SKILLS DEVELOPMENT (COMMON TO ALL BRANCHES)	L T P C 0 0 2 1

OBJECTIVES:

The Student should be made to:

- Enhance the development of students by focusing on soft skills
- Develop skills of the students through individualand group activities
- Shape students attitude and behavior through activities
- Analyze the characteristics of the students for self-development
- Prepare themselves for the recruitment processes

UNIT ISOFT SKILLS ARE IMPORTANT FOR SUCCESS **6**

Importance of Soft Skills – Types – Industrial needs – Development of skills – Employees Expectation – Success of Employees.

UNIT II CORPORATE COMMUNICATION **6**

Needs and Development of Communication – Customers Relationship – Improving Informal Communication – Formation of Presentations – Public Speaking – Telephone and Email Etiquettes.

UNIT III DISCUSSIONS **6**

Introduction to Discussion – Importance and types of Discussion – Spontaneous conversation – Plan for Discussions – Panel Discussions – Visual Aid Discussions – Debate.

UNIT IV SELF ANALYSIS **6**

Who am I –Identifying or searching one's own Strength, Weakness –, opportunities and threats (SWOT Analysis) – Benefits of SWOT Analysis – Importance of Self Confidence, Self Esteem, Self Development and Self Introspection.

UNIT V CREATIVITY AND GOAL SETTING **6**

Thinking out of the box – Lateral Thinking – Positive Thinking – Results of Smart Work – Application of Creativities – Short Term and Long term Goals – Life Time Goals.

TOTAL: 30 PERIODS

CHAIRMAN
BoS(S&H)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learners will recognize the importance of Soft skills in Professional life
- Improve oral and Listening Skills
- Enhance students' ability in GDs, Presentations and interviews
- Develop one's strength in setting of goals and developing creative
- Become a good team worker in the society

TEXT BOOKS:

1. "Soft Skills", Career Development Centre, Green Pearl Publications, 2015.

REFERENCES :

1. Covey Sean, "Seven Habits of Highly Effective Teens", New York, Fireside Publishers, 1998.
2. Carnegie Dale, "How to Win Friends and Influence People", New York: Simon and Schuster, 1998.
3. Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, 2011.

CHAIRMAN
BoS(S&H)

BME
24/1/22

20MA404 **PROBABILITY AND STATISTICS**

(Common to AGE, BME, AD & IT branches)

L	T	P	C
3	1	0	4

OBJECTIVES:

The student should be made to,

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- Introduce the basic concepts of probability and random variables.
- Introduce the basic concepts of two dimensional random variables.
- Acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- Introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I RANDOM VARIABLES **12**

Discrete and continuous random variables –Moments –Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO -DIMENSIONAL RANDOM VARIABLES **12**

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

UNIT III TESTING OF HYPOTHESIS **12**

Sampling distributions –Estimation of parameters – Statistical hypothesis -Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion -Contingency table (test for independent) -Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS **12**

One way and two way classifications -Completely randomized design –Randomized block design – 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL **12**

Control charts for measurements(X and R charts) –Control charts for attributes (p, c and np charts) –Tolerance limit-Acceptance sampling

TOTAL: 60 PERIODS

Chairman
BoS/S&H

OUTCOMES:

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

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

Text Books:

1. S.C.Gupta, and V.K.Kapoor "Fundamental of Mathematical Statistics ", S Chand Publications 11th edition, 2018.
2. Richard A. Johnson., "Probability and Statistics for Engineers", Pearson Education, 9th edition, 2018.

References:

1. Devore. J.L.,"Probability and Statistics for Engineering and the Sciences, Cengage Learning, New Delhi, 8th edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, New Delhi, 4th edition, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd edition, Elsevier, 2004.
4. Veerarajan,T "Probability, Statistics and Random with Queueing Theory and Queueing Networks" Tata McGraw-Hill Publishing Company Limited, New Delhi. 3rd edition, 2010.
5. Moorthy M.B.K "Probability and Statistics" Scitech Publications (India) Pvt Ltd., 8th edition, 2011.

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BoS/S&H

20BM401	PATHOLOGY AND MICROBIOLOGY	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand about pathological cell degeneration and tumors
- Know the etiology and remedy in treating the pathological diseases
- Gain knowledge on the structural and functional aspects of microorganisms
- Empower the importance of microbial identification and microscopic techniques
- Have a basic understanding on the immunity and immunological techniques

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA **9**

Cell injury – Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification – Dystrophic and Metastatic cellular adaptations of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours, biopsy methods.

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS **9**

Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, Chronic venous congestion. Hematological disorders – Bleeding disorders, Leukaemias, Lymphomas Haemorrhage.

UNIT III MICROBIOLOGY **9**

Structure of Bacteria and Virus, Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria, culture media and its types, culture techniques and observation of culture, Disease caused by bacteria, fungi, protozoal, virus and helminthes.

UNIT IV MICROSCOPES **9**

Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM & SEM). Preparation of samples for electron microscope. Staining methods – simple gram staining and AFB staining.

UNIT V IMMUNOPATHOLOGY **9**

Natural and artificial immunity, opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection, Auto Immune disorders: Basic concepts and classification, SLE Antibodies and its types, antigen and antibody reactions, immunological techniques: immune diffusion, immuno electrophoresis, RIA and ELISA, monoclonal antibodies.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Analyze structural and functional aspects of living organisms
- Explain the function of microscope
- Discuss the importance of public health
- Describe methods involved in treating the pathological diseases
- Discuss the immunity and immunological techniques

TEXT BOOKS:

1. Ramzi S Cotran, Vinay Kumar and Stanley L Robbins. "Pathologic Basis of Diseases", 7th Edition,WB Saunders Co. 2005.
2. Ananthanarayanan and Panicker, "Microbiology", Orientblackswan, 10th Edition, 2017.
3. Pelczar, Jr Chan E C S and Noel R Krieg, "Microbiology", 5th Edition, Tata McGraw Hill, 2006.

REFERENCES:

1. Underwood J C E, "General and Systematic Pathology", Churchill Livingstone, 3rd Edition, 2000.
2. Dubey R C and Maheswari D K, "A Text Book of Microbiology", Chand & Company Ltd, 2007.
3. Prescott, Harley and Klein, "Microbiology", 10th Edition, McGraw Hill, 2017.

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BoS (BME)

20BM402	SENSORS AND MEASUREMENTS	L T P C 2 0 2 3

OBJECTIVES:

The Student should be made to:

- Understand the purpose of measurement, the methods of measurements, errors associated with measurements
- Know the principle of transduction, classifications and the characteristics of different transducers
- Identify the significance of preamplifiers and other signal conditioning circuits
- Know the different bridges used for measurement
- Know the different display and recording devices

UNIT I SCIENCE OF MEASUREMENT **6**

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements and their statistical analysis – Calibration – Primary and Secondary standards.

UNIT II DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS **6**

Strain Gauge: Gauge factor, sensing elements, configuration and unbonded strain gauge. Capacitive transducer – Inductive transducer, LVDT, RTD, Thermistor characteristics, Active type: Thermocouple – characteristics.

UNIT III PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS **6**

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer – Equivalent circuit and its characteristics.

UNIT IV SIGNAL CONDITIONING CIRCUITS **6**

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges – wheat stone bridge, Kelvin, Maxwell, Hay, Schering.

UNIT V DISPLAY AND RECORDING DEVICES **6**

Digital voltmeter – Multimeter – CRO – Block diagram, CRT – vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, thermal recorder.

TOTAL: 30 PERIODS

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LIST OF LABORATORY EXPERIMENTS TO DEMONSTRATE:

1. Characteristics of various temperature sensors – RTD, Thermistor and Thermocouple
2. Displacement measurement using LVDT
3. Characteristics of various light sensors –LDR, Photodiode and Phototransistor
4. Measurement of resistance using DC bridges
5. Measurement of inductance using Maxwell bridge
6. Measurement of capacitance using Schering bridge
7. Measurement of amplitude, time, frequency using CRO

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Measure various electrical parameters with accuracy, precision, resolution
- Select appropriate passive or active transducers for measurement of physical phenomenon
- Select appropriate light sensors for measurement of physical phenomenon
- Use AC and DC bridges for relevant parameter measurement
- Employ Multimeter, CRO and different types of recorders for appropriate measurement

TEXT BOOKS:

1. Sawhney A K, "Electrical Electronics Measurement and Instrumentation", Dhapat Rai & Co, New Delhi, 19th Revised Edition 2014.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th Edition, Wiley India Pvt Ltd, New Delhi, 2015.

REFERENCES:

1. Ernest O Doebelin and Dhanesh N Manik, "Measurement systems, Application and Design", 6th edition, McGraw-Hill, 2012.
2. Khandpur R. S, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw-Hill, New Delhi, 2014.
3. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd Edition, Prentice hall of India, New Delhi, 2015.
4. Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1st Edition, 2016.

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BoS/BME

20EC402	LINEAR INTEGRATED CIRCUITS (COMMON TO BME, ECE, EEE)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Learn the basic building blocks of linear integrated circuits
- Understand the linear and non-linear applications of operational amplifiers
- Acquire the concept and applications of analog multipliers and PLL
- Analyze ADC and DAC using op-amp
- Study the concepts of waveform generation using op-amp and some special function ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Basic information about Op-amps -Symbol, Power Supply Connection, Ideal Operational Amplifier, Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower, Differential Amplifier, Op-amp - Block Diagram, DC characteristics, AC characteristics - Frequency response, Frequency Compensation, Slew rate, open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Basic Op-amp Applications - Scale Changer, Summing Amplifier, Subtractor, Instrumentation amplifier, V-to-I and I-to-V converters, Precision Rectifier, Peak detector, Clipper and Clamper, Sample and Hold circuit, Log amplifier, Antilog amplifier, Differentiator, Integrator, Comparators, Schmitt trigger, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, Analog multiplier ICs and their applications, PLL-basic Principles, analysis, Voltage controlled oscillator, Monolithic PLL IC 565, Application of PLL- Frequency Multiplication, Division, Frequcncy tranlstion, FM demodulation, FSK demodulator.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Basic DAC techniques - weighted resistor type, R-2R Ladder type, inverted R-2R Ladder DAC, A/D Converter- Flash type, Counter Type A/D converter, Successive Approximation type, Single Slope type, Dual Slope type, DAC/ADC Specifications.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator using op-amp, Function generator, Timer IC 555 - Functional Description, Monostable operation, Astable operation, IC Voltage regulators - fixed voltage series regulator - IC 723 general purpose regulator - Switching regulator, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the basic building blocks and characteristics of linear integrated circuits
- Recognize the linear and non-linear applications of operational amplifiers

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BoS /ECE

- Know the concept of Analog multipliers and PLL and their applications
- Realize A/D Converter and D/A Converter using op-amp
- Acquire the concept of waveform generators using op-amp and special function ICs

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 4th Edition, 2018.

REFERENCES:

1. S. Salivahanan& V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill, 2nd Edition, 6th Reprint, 2010.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata McGraw-Hill, 2016
3. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 5th Edition, 2009.
5. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education,4th Edition,2001.

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BoS /ECE

20EC305	ANALOG AND DIGITAL COMMUNICATION (FOR BME AND IT ONLY)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand about different types of Communication systems and AM.
- Gain knowledge about different types of FM techniques for transmission.
- Know the concept of pulse modulation techniques and its types.
- Learn about base band data transmission and adaptive equalization techniques
- Classify different type of digital modulation techniques.

UNIT I AMPLITUDE MODULATION **9**

Elements of Communication Systems – AM: Theory, Envelope Detection, Limitations- Double Sideband Suppressed Carrier Modulation: Theory, Coherent Detection – Quadrature Carrier Multiplexing – Single Sideband Modulation: Theory, Modulators for SSB, Coherent Detection, Frequency Translation- Vestigial Sideband Modulation: Motivation, Sideband Shaping Filter, Coherent Detection.

UNIT II ANGLE MODULATION **9**

Angle Modulation: Basic Definitions, Properties, Relationship between PM and FM waves- Narrow band Frequency Modulation –Wide band Frequency Modulation: Bandwidth, Generation of FM waves - Demodulation of FM signals: Frequency Discriminator, Phase Locked Loop, FM Stereo Multiplexing.

UNIT III PULSE MODULATION **9**

Sampling Process: Sampling Theorem – Pulse Amplitude Modulation: Sample and Hold Filter- Pulse Position Modulation -Transition from Analog to Digital: Quantization process – Pulse Code Modulation: Regeneration of signal in channel – Delta Modulation: System details, Quantization Errors, Delta/Sigma Modulation – Differential Pulse Code Modulation – Line codes –Time Division Multiplexing: Synchronization, Impulse Radio.

UNIT IV BASEBAND DATA TRANSMISSION **9**

Baseband Transmission of Digital Data –The Inter Symbol Interference problem – The Nyquist Channel – Raised cosine pulse spectrum: Transmission Bandwidth Requirement, Additional Properties – M-ary Data Transmission – The Eye Pattern – Equalization: Zero Forcing Equalization.

UNIT V DIGITAL BAND PASS MODULATION TECHNIQUES **9**

Preliminaries – Binary Amplitude Shift Keying- Phase Shift Keying: Binary Phase Shift Keying (BPSK), Generation and Coherent Detection of BPSK signals, Quadrature phase Shift Keying, Generation and Coherent Detection of QPSK signals, Offset Quadrature phase Shift Keying – Frequency Shift Keying: Binary Frequency Shift Keying, Continuous Phase Frequency Shift Keying, Minimum Shift Keying – Non coherent Digital Modulation Schemes: Differential Phase Shift Keying -Orthogonal Frequency Division Multiplexing.

TOTAL: 45 PERIODS

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BoS (ECE)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the principles of Amplitude Modulation and its types
- Analyze the methods of Frequency Modulation
- Illustrate the working principles of Pulse modulation schemes
- Gain Knowledge about base band data transmission and adaptive equalization techniques
- Understand the concepts of modern modulation methods

TEXT BOOKS:

1. Singal T L, "Analog & Digital Communications", Tata McGraw-Hill Education, 1st Edition,2012.

REFERENCES :

1. Simon Haykin and Michael Moher, "Introduction to Analog and Digital Communications", John Wiley, 2nd Edition, 2007.
2. Bernard Sklar,"Digital Communication: fundamentals and applications", Addision Wesley, 2nd Edition, 2007.
3. Taub H , Schilling D L , Saha G, "Principles of Communication", 3rd Edition,2007.

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BoS (ECE)

20EE405	BASICS OF ELECTRICAL ENGINEERING (FOR BME ONLY)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Know the basic concepts of magnetic circuits and transformers
- Acquire knowledge on working of DC machines
- Describe the operation of AC electrical machines
- Learn the principles and operation of measuring instruments
- Study the energy saving methods and different ways of illumination

UNIT I MAGNETIC CIRCUITS AND TRANSFORMERS 9

Ampere's law – Magnetic quantities – Series and parallel magnetic circuits – Magnetic materials and B-H relationship – Electromagnetic induction – Self and mutual induction – Energy stored in magnetic circuit – Losses in magnetic circuits. Transformer: Construction and operation of single phase transformer – Ideal transformer – Applications.

UNIT II DC MACHINES 9

DC Machines: Construction, Principle of operation, armature windings, EMF equation, Torque equation, Operation of a DC machine as a generator and motor – Characteristics of DC generators and motors.

UNIT III AC MACHINES 9

Three phase induction motor: Construction, principle of operation. Single phase induction motor: Construction, working principle and types. Synchronous Generator: Construction, Principle of operation, EMF equation. Synchronous motor: principle and operation.

UNIT IV ELECTRICAL MEASUREMENTS AND INSTRUMENTATION 9

Introduction – Classification of instruments – Operating principles – Essential features of measuring instruments (Elementary treatment only) – Permanent magnet moving coil (PMMC) instrument – Moving iron instruments – Energy meter – Oscilloscope – Frequency and phase measurement.

UNIT V UTILIZATION OF ELECTRICAL POWER 9

Terms used in illumination – Laws of illumination – Sources of light – Arc lamps – Gaseous discharge lamps: Sodium vapour lamp, High pressure Mercury vapour lamp, Fluorescent tubes, Compact fluorescent lamps (CFLs) – Domestic refrigerator – Air conditioner – Tariffs.

TOTAL: 45 PERIODS

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BoS (EEE)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the working principle of transformers
- Understand the operation and characteristics of DC motors
- Compare the principle and operation of various AC electrical machines
- Illustrate the working of measuring instruments
- Analyze the energy saving methods and different ways of illumination

TEXT BOOKS:

1. Kothari D P and Nagarath I J, "Basic Electrical and Electronics Engineering", 3rd Reprint, McGraw Hill Education (India) Private Limited, 2016.
2. Gupta J B, "Utilization of Electric Power and Electric Traction", S K Kataria and Sons, 2012.

REFERENCES:

1. Theraja B L, "Fundamentals of Electrical Engineering and Electronics", S Chand & Co, 2008.
2. Vijay Kumar Garg, "Basic Electrical Engineering (A Complete Solution)", Wiley Reprint, 2015.
3. Sivanagaraju S, Balasubba Reddy M and Srilatha D, "Generation and Utilization of Electrical Energy", Pearson Education, 2010.
4. Sukhija M S and Nagsarkar T K, "Basic Electrical and Electronic Engineering", Oxford, 2016.

CHAIRMAN
BoS (EEE)

20MC003	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

The student should be made to:

- To teach history and philosophy of Indian constitution.
- To summarize powers and functions of Indian government.
- To explain structure and functions of local administration.
- To demonstrate the organization and working of the Judiciary.
- To discuss financial power and emergency provisions.

UNIT I INTRODUCTION **6**

Historical background – Government of India act – Indian councils act – Making of the constitution -Philosophy of the Indian constitution – Preamble.

UNIT II GOVERNMENT OF THE UNION **6**

Powers and Functions of President and Prime Minister - Council of Ministers – President in relation to his council - Legislature structure and functions of Loksabha and Rajyasabha – Speaker.

UNIT III GOVERNMENTS OF THE STATES AND LOCAL GOVERNMENT **6**

The state executive: General structure – Governor – Council of ministers – State legislature. Local government - Panchayat –Municipality– Powers, Authority and Responsibilities of municipalities.

UNIT IV THE JUDICATURE **6**

Organization and Composition of Judiciary – Constitution – Appointment - Qualifications - Powers and functions of the supreme court– High courts – Control over subordinate courts.

UNIT V THE FEDERAL SYSTEM **6**

Distribution of financial powers: Need, principles-Underlaying distribution of tax revenues- Distribution of legislative power – Interstate relation - Emergency provisions.

TOTAL: 30 PERIODS

Chairman
BoS/S&H

OUTCOMES:

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

- Understand history and philosophy of Indian constitution
- Realize powers and functions of Indian government
- Acquire awareness on structure and functions of local administration
- Enhance knowledge about organization and composition of judiciary
- Explore the distribution of financial powers and emergency provisions

TEXT BOOKS:

1. Basu D.D,"Introduction to Indian Constitution",Prentice Hall of India,New Delhi,2015.
2. Gupta D.C,"Indian Government and Politics",Vikas Publishing House,New Delhi, 2010.

REFERENCES:

1. Pylee M.V,"Introduction to the Constitution of India",Vikas Publishing House,NewDelhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.
3. The Constitution of India, 1950 (Bare Act), Government Publication.
4. Jain M P, Indian Constitution Law, Seventh Edition, Lexis Nexis, 2014.
5. Busi S N, Ambedkar B R framing of Indian Constitution, First Edition, 2015.

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BoS/S&H

20BM403L PATHOLOGY AND MICROBIOLOGY LABORATORY

L	T	P	C
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OBJECTIVES:

The student should be made to:

- Use compound microscope
- Practice on chemical examinations, Histopathological examinations etc.,
- Appreciate different staining methods
- Identification of microbial cell structure
- Studies on Haematological slides and bone marrow

LIST OF EXPERIMENTS:

1. Urine physical and chemical examination (protein, reducing substances, ketones, bilirubin and blood)
2. Study of parts of compound microscope
3. Histopathological slides of benign and malignant tumours
4. Basic staining – Hematoxylin and eosin staining.
5. Special stains – Cresyl Fast Blue (CFB)- Trichrome – oil red O – PAS
6. Capsule stain
7. Simple stain
8. Gram stain
9. AFB stain
10. Antigen-Antibody reaction Immuno electrophoresis
11. Slides of malarial parasites, micro filaria and leishmania donovani
12. Haematology slides of anemia and leukemia
13. Study of Bone marrow charts

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Classify the difference between normal and compound microscopes
- Interpret the chemical examinations
- Deduct the importance of various staining methods
- Discuss the slides of anemia and leukemia
- Study the bone marrow charts

TEXT BOOK:

1. Ramnik Sood, "Textbook of Medical Laboratory Technology", 6th Edition, Jaypee Brothers, Medical Publishers, 2009.

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BoS (BME)

20EC407L **INTEGRATED ELECTRONICS LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES:

The Student should be made to:

- Get exposure to the Fundamental Logic Gates
- Design the Adder, Subtractor, Multiplexer, Encoder, Counters and Code converters
- Understand the characteristics of operational amplifier
- Know the importance of Instrumentation amplifier in rejecting the common mode signals
- Apply operational amplifiers in linear and nonlinear applications

LIST OF DIGITAL EXPERIMENTS:

1. Verification of truth table for basic logic gates.
2. Design of Half Adder, Full adder, Half Subtractor and Full Subtractor using logic gates
3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483
4. Design and implementation of Multiplexer and De-multiplexer using logic gates
5. Design and implementation of encoder and decoder using logic gates
6. Construction and verification of 4 bit ripple counter and Mod-10 or Mod-12 Ripple counters
7. Design and implementation of code converters such as BCD to excess-3 code and vice versa

LIST OF LINEAR INTEGRATED ELECTRONICS EXPERIMENTS:

1. Inverting, Non inverting and differential amplifiers
2. Integrator and Differentiator
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters
5. Astable and Monostable multivibrators using NE555 Timer.
6. Phase shift and Wien bridge oscillators using Op-amp.

OUTCOMES:

On successful completion of this course, the students will be able to,

- Appreciate the truth table of basic gates
- Realize the importance of various combinational circuits
- Recognize the significance operational amplifier in the analog circuits
- Identify the applications of Instrumentation amplifier in amplifying small signals
- Comprehend the understanding of linear and nonlinear circuits

TOTAL: 30 PERIODS

CHAIRMAN
BoS (ECE)

20EEC401L	LIFE SKILLS AND PERSONALITY DEVELOPMENT (COMMON TO ALL BRANCHES)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The student should be made to:

- Create self- confident among the students by the training
- Develop good personality for mature outlook in different circumstances
- Encourage effective presentation skills
- Dramatize role play by assigning the best role
- Enhance team building and time management skills

UNIT I CAREER PLANNING **6**

Introduction – Benefits of Career Planning – Expectation and Development – Guidelines for choosing a Career – Future Planning – Evaluation of planning

UNIT II ATTITUDE **6**

Introduction – Rightness of Attitude and behavior – Formation of attitudes – Evolving Behavior of a person – Creating right attitudes – Approaches of Challenges – Lessons from Attitude.

UNIT III ROLE PLAYING **6**

Introduction – settings of role plays – Principles and Purpose – importance of communication in role plays – Arrangement of points and character – Extempore Talk – Debates – Emotional Intelligence.

UNIT IV TEAM BUILDING **6**

Purpose of Creating Team – Exploring Team roles and Processes – Importance of Building and Developing Strong Team – Leadership Qualities – Success of Team Building.

UNIT V TIME MANAGEMENT **6**

Value of time – Concept and applications of time management – Causes for Wasting of Time – Methods of Time Management – Diagnosing Time Management – Planning for presentation – To-do-list – Prioritizing work.

TOTAL: 30 PERIODS

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BoS (S&H)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Improve the leadership skills by identifying the strengths of a team
- Learn to lead a team on a project in an organization
- Helps students to perform on a distinct role and learn to face the challenges
- Build a strong team to achieve their goals with the right choice of people
- Develop the time management skills to achieve success

TEXT BOOKS:

1. "Soft Skills", Career Development Centre, Green Pearl Publications, 2015.

REFERENCES :

1. Thomas A Harris, "I Am Ok, You Are Ok", Harper and Row, New York, 1972.
2. Daniel Coleman, "Emotional Intelligence", Bantam Book, 2006.
3. NiraKonar, "Communication Skills for Professionals", Eastern Economy Edition, 2010.
4. Daniel Coleman, "Emotional Intelligence", Bantam Book, 2006.

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BoS (S&H)

20BM501	BIOCONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn the elements of control system and their modeling using various techniques
- Become skilled at various methods of analyzing the time response of control system
- Analyze the systems in frequency domain and to understand the concept of stability
- Widen the knowledge of modeling of physiological control systems
- Apply mathematical modeling principles in understanding the various fundamental biological systems

UNIT I CONTROL SYSTEM MODELING **9**

Control System –Introduction, Open loop and Closed loop systems, Differential equation – Transfer function, Modeling of Mechanical Translational and Rotational Systems, Electrical systems, Analogous system, Block diagram reduction Techniques, Signal flow graph.

UNIT II TIME RESPONSE ANALYSIS **9**

Time response, Time response of First Order Systems and Second Order Systems, Time domain specifications, Steady state error, Generalized error co–efficient, Routh- Hurwitz criteria of stability, Root locus technique

UNIT III FREQUENCY RESPONSE ANALYSIS **9**

Frequency domain specifications - Polar plots, Bode plots, Nyquist plot, Nyquist stability criterion, closed loop stability, Constant M and N circles, Nichol's chart.

UNIT IV PHYSIOLOGICAL CONTROL SYSTEMS **9**

Physiological Control Systems: A simple Example - Difference between engineering and physiological control system - Generalized System Properties - Models with combinations of system elements- -Linear Models of Physiological Systems Distributed parameter versus lumped parameter models-State Space Models.

UNIT V BIOLOGICAL CONTROL SYSTEM ANALYSIS **9**

Determination of steady state operating point - Study of regulation of cardiac output, Study of transient response analysis of neuromuscular reflex model action, Study of frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the need for mathematical modeling of various systems, representation of systems in block diagrams and signal flow graphs
- Analyze the time response of various systems and discuss the concept of system stability
- Analyze the frequency response characteristics of various systems using different charts
- Understand the concept of basic physiological systems
- Comprehend the application aspects of time and frequency response analysis in physiological control systems

CHAIRMAN
BoS(BME)

TEXT BOOKS:

1. Nagrath I J and Gopal M, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. Michael C K Khoo, "Physiological Control Systems", IEEE Press, Prentice Hall of India, 2005.

REFERENCES:

1. Benjamin C Kuo, "Automatic Control Systems", Prentice Hall of India, 1995.
2. John Enderle Susan Blanchard, Joseph Bronzino "Introduction to Biomedical Engineering", Second Edition, Academic Press, 2005.
3. Richard C Dorf and Robert H Bishop, "Modern Control Systems", Pearson, 2004.
4. Salivahanan S, Rengaraj R and Venkatakrishnan G R, "Control Systems Engineering", First Edition, Pearson, 2015.
5. Anand Kumar A, "Control Systems", PHI Learning Private Limited, 3rd Edition, 2009.

CHAIRMAN
BoS(BME)

20BM502 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Illustrate the origin of bio potentials and its propagation
- Understand the different types of electrodes and its placement for various recordings
- Design bio amplifier for various physiological recordings
- Learn the different measurement techniques for non-physiological parameters
- Summarize different biochemical measurements

UNIT I BIOPOTENTIAL ELECTRODES **9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half-cell potential, contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes – surface, needle and micro electrodes and their equivalent circuits. Recording problems – motion artifacts, measurements with two electrodes.

UNIT II BIOPOTENTIAL MEASUREMENTS **9**

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG – unipolar and bipolar mode. Recording of ERG, EOG and EGG.

UNIT III SIGNAL CONDITIONING CIRCUITS **9**

Need for bio-amplifier – single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation – isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering.

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS **9**

Temperature, respiration rate and pulse rate measurements. Blood pressure: indirect methods – Auscultatory methods, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement. Indicator dilution, thermal dilution and dye dilution methods, Electromagnetic and ultrasound blood flow measurement.

UNIT V BIOCHEMICAL MEASUREMENT AND BIOSENSORS **9**

Biochemical sensors – pH, pO_2, pCO_2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers – colorimeter, Sodium Potassium Analyzer, spectrophotometer, blood cell counter, auto analyzer(simplified schematic description) – Bio Sensors – Principles – amperometric and voltometric techniques.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Differentiate different bio potentials and its propagations
- Illustrate different electrode placement for various physiological recordings
- Design bio amplifier for various physiological recordings
- Explain various technique for non-electrical physiological measurements
- Demonstrate different biochemical measurement techniques

TEXTBOOK:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2nd Edition, Prentice Hall of India, New Delhi, 2015.

REFERENCES:

1. John G Webster, "Medical Instrumentation Application and Design", 4th Edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
4. Khandpur R S, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2014.

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20EC504	DIGITAL SIGNAL PROCESSING (Common to BME & ECE)	L T P C 3 0 2 4

OBJECTIVES:

The Student should be made to:

- Ascertain the concepts of DFT and FFT
- Gain knowledge of designing FIR and IIR digital filters
- Become skilled at the finite word length effects
- Study the architecture and programming concepts of digital signal processors
- Gain knowledge about various applications of DSP

UNIT I DISCRETE FOURIER TRANSFORM **9**

Basic elements of DSP – Direct computation of DFT, Properties of DFT, Circular convolution, Computation of DFT & IDFT using Radix-2 FFT algorithms – Decimation in Time(DIT) FFT algorithm, Decimation in Frequency(DIF) FFT algorithm

UNIT II FIR AND IIR DIGITAL FILTERS **9**

FIR Filters: Magnitude response and phase response of digital filters – Design of linear phase FIR filters using Windows (Rectangular, Hamming and Hanning Window) – Gibbs phenomenon – FIR filter structures: Direct form, Cascade form, Linear Phase realization.

IIR Filters: Design of digital IIR filters from analog filters – Bilinear transformation – Impulse Invariance technique – Butterworth and Chebyshev Filters – Warping effect, Prewarping.

UNIT III FINITE WORD LENGTH EFFECTS **9**

Fixed point and floating point number representation – Quantization noise – Derivation for quantization Noise power-Truncation and Rounding – Input quantization error – Coefficient Quantization error - Product quantization error – Limit cycle oscillations – Dead band.

UNIT IV DIGITAL SIGNAL PROCESSOR **9**

Introduction to DSP processors, MAC Unit, Von Neumann, Harvard architecture – VLIW architecture – Pipelining – Architecture of TMS320C5X Digital Signal Processor – Addressing modes – Instruction set.

UNIT V APPLICATIONS OF DSP **9**

Channel Vocoder- Subband coding of speech signals – Compact disc digital audio system – Fetal ECG monitoring – DSP based closed loop controlled anesthesia -Adaptive noise cancellation.

LIST OF THE EXPERIMENTS:

SOFTWARE/SIMULATION:

1. Generation of signals
2. Basic operations on signals
3. Linear and Circular Convolution
4. Computation of DFT
5. Design of FIR filters
6. Design of IIR filters
7. Up sampling and Down sampling

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DSP PROCESSOR BASED IMPLEMENTATION:

1. Study of architecture of Digital Signal Processor
2. Generation of Waveforms
3. Basic operations using addressing modes

EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. PCs with Fixed/Floating point DSP Processors (Kit/Add-on Cards) Coding Schemes. (15 Nos)
2. MATLAB with Simulink and Signal Processing Tool Box or Equivalent Software in desktop systems. (15 Nos)
3. CRO (20MHz). (10 Nos)

TOTAL: 75 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Implement the FFT algorithms to get faster realization.
- Design the digital FIR and IIR filters using different transformation techniques
- Analyze the impacts of finite word length effects in filter design
- Write programs for any specific application in DSP Processors
- Apply the applications of DSP in real time

TEXT BOOK:

1. S Salivahanan, A Vallavaraj, C Gnanapriya, "Digital Signal Processing", Second Edition, Tata McGraw Hill, 2016.

REFERENCES:

1. John G Proakis and Dimitris G Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Fourth edition, Pearson Education, 2017.
2. Sanjit K Mitra, "Digital Signal Processing-A Computer Based Approach", McGraw Hill Education, 2013.
3. B Venkataramani and M Bhaskar, "Digital Signal Processors, Architecture, Programming" Tata McGraw Hill 2002.
4. Emmanuel C. Ifeachor and Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", 2E, Prentice Hall, 2013

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BoS/ECE

20MC002	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

Objectives

The students should be made to:

- Understand the need of value education and human aspiration
- Know the difference between self and body
- Recognize the harmony in the family and society
- Understand harmony in nature
- Identify the human values and ethics

UNIT I INTRODUCTION TO VALUE EDUCATION **9**

Value Education – need and process, Self-Exploration – process, Basic Human Aspirations - Continuous Happiness and Prosperity, Basic requirement for fulfillment of Human Aspirants, Understanding Happiness and Prosperity – Continuity of Happiness from Physical Facility.

UNIT II HARMONY IN THE HUMAN BEING **9**

Human being as a co-existence of the self and the Body - The needs of Self and Body, Body as an Instrument - The Self as the Seer- Doer-Enjoyer, Harmony in the self, Harmony of the Self with the Body –Programme for Self – regulation and health.

UNIT III HARMONY IN THE FAMILY AND SOCIETY **9**

Family as the basic unit of human interaction , Understanding Relationship, Trust as the foundational value, Respect as the Right Evaluation, Harmony in the society – Understanding Human Goal, Harmony from Family Order to World Family Order – Universal Human Order - Scope.

UNIT IV HARMONY IN THE NATURE AND EXISTENCE **9**

Nature - as Collections of Units, Classification of Units into Four Orders, Interconnectedness, and mutual fulfillment among the four orders of nature, self-regulation in Nature, Understanding Existence as Units in Space, Existence as Co-existence.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS **9**

Natural Acceptance of Human Values - Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Constitution, Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production System and Management Models – Typical case, Strategies for Transition towards value based life and profession.

TOTAL: 45 PERIODS

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Outcome:

On completion of this course, the students will be able to

- Understand the significance of value education and distinguish between values and skills.
- Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
- Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings.
- Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
- Distinguish between ethical and unethical practices and understand the human values.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2nd Revised Edition, 2019.

References:

1. Tripathi A N, "Human Values", New Age Intl. Publishers, New Delhi, 2009.
2. Govindarajan M, Natrajan S and Senthilkumar V S, "Engineering Ethics (Including Human Values)" Eastern Economy, PHI, 12th Edition, 2011.
3. Govindarajan M and Natrajan S, "Professional Ethics and Human Values", PHI, 2011.
4. Banerjee B P, "Foundation of Ethics and Management", Excel Publication, 2005.
5. Bajpai B L, "Indian Ethos and Modern Management", New Royal Book Co, Lucknow, Reprinted 2008.
6. Seebauer and Robert L Berry, "Fundamentals of Ethics for Scientist and Engineers", Oxford University Press, 2000.

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BoS(S&H)

20BM503L BIOMEDICAL INSTRUMENTATION LABORATORY

L	T	P	C
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OBJECTIVES:

The student should be made to:

- Understand the significance of designing a pre-amplifier
- Know about the filter characteristics and its diverse applications
- Design amplifiers to different biological signals
- Analyze the advantages of using optical isolation amplifiers during the signal acquisition in human being
- Measure the noteworthy biological parameters of living beings

LIST OF EXPERIMENTS:

1. Design of pre amplifiers to acquire bio signals along with impedance matching circuit using suitable IC's
2. Design of ECG Amplifiers with appropriate filter to remove power line and other artifacts
3. Design of EMG amplifier
4. Design a suitable circuit to detect QRS complex and measure heart rate
5. Design of frontal EEG amplifier
6. Design of EOG amplifier to detect eye blink
7. Design a right leg driven ECG amplifier
8. Design and study the characteristics of optical isolation amplifier
9. Design a Multiplexer and Demultiplexer for any two biosignals
10. Measurement of pulse-rate using Photo transducer
11. Measurement of pH and conductivity
12. Measurement of blood pressure using sphygmomanometer
13. Measurement and recording of peripheral blood flow
14. Design a PCB layout for any bio amplifier using suitable software tool

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Appreciate the difference between an amplifier and pre-amplifier with its design knowledge
- Recognize different types of filters through its characteristics and synthesize it wherever necessary
- Understand the necessity of designing special amplifiers for the particular biological signals
- Realize the importance of isolation amplifier during signal acquisition from human being
- Appraise different biological parameter measurements while diagnosing a patient

CHAIRMAN
BoS(BME)

20BM504L	MINI PROJECT-I	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Identify problems and needs of the society and industries.
- Divide the complex problems into simple modules.
- Identify relevant solutions by doing extensive literature survey.
- Prepare a schematic diagram about the plan of execution.
- Propose appropriate solutions through the modern tools and techniques.

The students may choose a topic and work with due approval from Head of the Department. Students may do the Mini Project in a group. The maximum number of students in a group should not exceed 3. Every student group will be doing their project under the guidance of a Faculty member. A comprehensive Mini Project report should be prepared by each group after completing the work to the satisfaction of the Supervisor. The progress of the Mini Project will be evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. The review committee will be a two member team. The presence of Mini Project supervisor along with the review committee for the group concerned is mandatory during the review.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Determine the required solutions for the problem
- Develop strategies to break complex problems into simpler modules
- Experiment and do analysis on the empirical data arrived
- Create documentation on the experimental output and prepare presentation
- Demonstrate the project ideas to the reviewers and continues to improve the performance

CHAIRMAN
BoS (BME)

20EEC501L	PROFESSIONAL SKILLS DEVELOPMENT (COMMON TO ALL BRANCHES)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The student should be made to:

- Sharpen problem solving skills and to improve thinking ability of the students
- Drive the students to use language with great commitment and cooperation
- Expertise the creative thinking and presentation skills to meet company needs
- Develop and foster the soft skills through individual and group activities
- Expose students to right attitudinal and behavioral thoughts

UNIT I INTRODUCTION TO BASIC ARITHMETIC AND PERSONALITY TRAIT **6**

Aptitude – Numbers, Average, Percentage, Profit and loss, Picture pattern; Soft skills – Personality development, Professional ethics, Perception insights, attitude and behavioral changes.

UNIT II CONCEPT OF PROPORTIONALITY AND INTERPERSONAL SKILLS **6**

Aptitude – Time and work, Pipes and cisterns, Series completion, Critical reasoning; Soft skills – Developing self esteem, Significance of interpersonal behavior and interpersonal relationships.

UNIT III AN APPROACH TO COGNITIVE APTITUDE AND LEADERSHIP SKILLS **6**

Aptitude – Time, speed and distance, Boats and streams, Races and games, Syllogism; Soft skills – Leadership – Characteristics and importance of leadership, Roles and responsibilities of a good Leader.

UNIT IV CONTEMPORARY APTITUDE AND SITUATIONAL RESPONSES **6**

Aptitude – Crypt arithmetic, Ranking, Logarithms, Cubes, Analogy; Soft skills – Decision making – Process and challenges, Creative and Critical thinking.

UNIT V NON-VERBAL REASONONG AND INFLUENCING OTHERS **6**

Aptitude – Clocks, Non – verbal reasoning, Permutation, Classifications; Soft skills – Presentation skills – Make use of visual aids with modern tools, Insights on persistence and perseverance.

TOTAL: 30 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Ability to solve both analytical and logical problems in an effective manner
- Practice to organize and convey the information in such an optimistic way
- Deliver a professional and constructive presentation
- Recognize explicit assumptions and their consequences
- Access the needed information effectively and efficiently

TEXT BOOKS:

1. Aggarwal R S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing New Delhi, Revised Edition, 2017.
2. Murty G R K, "Soft Skills for Success", DGM Icfai Books, Revised Edition, 2005.

REFERENCES:

1. Abhijit Guha, "Quantitative Aptitude for All Competitive Examinations", McGraw Hill Education; Sixth edition, 2016.
2. Aggarwal R S, "A Modern Approach to Verbal and Non-Verbal Reasoning", S Chand Publishing, New Delhi, 2018.
3. Arun Sharma, "How to Prepare for Quantitative Aptitude for the CAT", McGraw Hill Education; Eighth Edition, 2018.
4. Covey Sean, "Seven Habits of Highly Effective Teens", Fireside Publishers, New York, 1998.
5. Carnegie Dale, "How to Win Friends and Influence People", Simon and Schuster, New York, 1998.

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BoS (S&H)

20BM601 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS **L T P C**
(Common to BME and ECE) **3 0 0 3**

OBJECTIVES:

The student should be made to:

- Understand the devices for measurement of parameters related to cardiology
- Illustrate the recording and measurement of EEG
- Demonstrate EMG recording unit and its uses
- Explain diagnostic and therapeutic devices related to respiratory parameters
- Understand the various sensory measurements that hold clinical importance

UNIT I CARDIAC EQUIPMENT **9**

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

UNIT II NEUROLOGICAL EQUIPMENT **9**

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

UNIT III MUSCULAR AND BIOMECHANICAL MEASUREMENTS **9**

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

UNIT IV RESPIRATORY MEASUREMENT SYSTEM **9**

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

UNIT V SENSORY MEASUREMENT **9**

Inhalators, Nebulizers, Psychophysiological Measurements –polygraph, Basal Skin Resistance (BSR), Galvanic Skin Resistance (GSR), Sensory responses – Audiometer – Pure tone, Speech, Eye Tonometer, Application Tonometer, Slit Lamp, Auto refractometer.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the working and recording setup of all basic cardiac equipment.
- Understand the working and recording of all basic neurological equipments
- Discuss the recording of diagnostic and therapeutic equipments related to EMG
- Explain about measurements of parameters related to respiratory system.
- Describe the measurement techniques of sensory responses

Ashok-7

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BoS/BME

TEXT BOOKS:

1. John G Webster, "Medical Instrumentation Application and Design", FourthEdition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2012.

REFERENCES:

1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill, 2003.
2. Geddes L A and Baker L E, "Principles of Applied Biomedical Instrumentation", Fourth Edition, A Wiley – Interscience Publication, 2008.
3. Lelie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.
4. Antony Y K Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illionois, USA, 2008.
5. Brown B H, Smallwood R H, Barber D C, Lawford P V and Hose D R, "Medical Physics and Biomedical Engineering", Second Edition, IOP Publishers, 2001.

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BoS/BME

20BM602 RADIOLOGICAL EQUIPMENTS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the generation of X-ray and its uses in imaging
- Describe the principle of Computed Tomography
- Know the techniques used for visualizing various sections of the body
- Learn the principles of different radio diagnostic equipment in Imaging
- Discuss the radiation therapy techniques and radiation safety

UNIT I MEDICAL X-RAY EQUIPMENT **9**

Nature of X-Rays, X-Ray absorption – Tissue contrast. X-Ray Equipment (Block Diagram) – X-Ray Tube, the collimator-Bucky Grid, power supply- Cathode and filament currents, Focusing cup-Thermionic emission, Electromagnetic induction, Line focus principle and the heel effect, X-Ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy- Angiography, Cine Angiography, Digital subtraction Angiography, Mammography.

UNIT II COMPUTED TOMOGRAPHY **9**

Principles of tomography-- CT Generations- X-Ray sources – Collimation, X-Ray detectors – Viewing systems – Spiral CT scanning-Ultra fast CT scanners. Advantages of Computed Radiography over film screen radiography: Time, Image quality, Lower patient dose- Differences between Conventional imaging equipment and Digital imaging equipment: Image plate, Plate readers, Image Characteristics, Image reconstruction techniques – Back projection and iterative method. Spiral CT-3D Imaging and its application.

UNIT III MAGNETIC RESONANCE IMAGING **9**

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. Block diagram approach of MRI system – system magnet (Permanent, Electromagnet and Super Conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving) and shim coils – electronic components- fMRI.

UNIT IV NUCLEAR MEDICINE TECHNIQUES **9**

Nuclear imaging – Anger scintillation camera – Nuclear tomography – single photon emission computer tomography, positron emission tomography – Recent advances-Radio nuclide imaging – Bone imaging, dynamic renal function- myocardial perfusion- Non imaging techniques – hematological measurement, Glomerular filtration rate, volume measurements - clearance measurement, whole body counting, surface counting

UNIT V RADIATION THERAPY AND RADIATION SAFETY **9**

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

TOTAL: 45 PERIODS

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BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the working principle of X ray machine and its application
- Illustrate the principle of Computed Tomography
- Interpret the technique used for visualizing various sections of the body using magnetic resonance imaging
- Demonstrate the applications of radio nuclide imaging
- Outline the methods of radiation safety

TEXT BOOKS:

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

REFERENCES:

1. Gopal B Saha, "Physics and Radiobiology of Nuclear Medicine", Third edition, Springer
2. Brown B H, Lawford P V, Small wood R H, Hose D R, Barber D C, " Medical Physics and Biomedical Engineering", CRC Press, 1999.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill, 2003.
4. Ragunathan P, "Magnetic Resonance Imaging and Spectroscopy in Medicine Concepts and Techniques', Paperback – Import, 2007.

Chairman
BoS/BME

20BM603 HOSPITAL MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the fundamentals of hospital administration and management.
- Realize the importance of managing the Human Resources effectively
- Know the market related research process
- Explore various information management systems and relative supportive services.
- Learn the quality and safety aspects in hospital.

UNIT I OVERVIEW OF HOSPITAL ADMINISTRATION **9**

Distinction between Hospital and Industry, Challenges in Hospital Administration-Hospital Planning-Equipment Planning-Functional Planning-Current Issues in Hospital Management – Telemedicine-Bio-Medical Waste Management

UNIT II HUMAN RESOURCE MANAGEMENT IN HOSPIAL **9**

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD – Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion-Transfer, Communication-nature, scope, barriers, styles and modes of communication

UNIT III MARKETING RESEARCH PROCESS **9**

Marketing information systems – Assessing information needs, Developing and Disseminating information – Market Research process – Other market research considerations – Consumer Markets and Consumer Buyer Behavior – Model of Consumer behavior – The buyer decision process – Model of business buyer behavior – Major types of buying situations – WTO and its implications.

UNIT IV HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES **9**

Management Decisions and Related Information Requirement – Clinical Information Systems – Administrative Information Systems – Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services – Laundry Services.

UNIT V QUALITY AND SAFETY ASPECTS IN HOSPITAL **9**

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance and Managing Health Care – Medical Audit – Hazard and Safety in a hospital set up.

TOTAL: 45 PERIODS

Chairman
BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the principles of Hospital administration
- Identify the importance of Human resource management
- List various marketing research techniques
- Identify information management systems and its uses
- Understand safety procedures followed in hospital

TEXTBOOKS:

1. Goyal R C, "Hospital Administration and Human Resource Management", PHI Learning Pvt Ltd, 2017.
2. Kunders G D, " Hospitals – Facilities Planning and Management", Tata McGraw Hill, New Delhi – Fifth Reprint 2007.

REFERENCES:

1. Cesar A Caceres and Albert Zara, "The Practice of Clinical Engineering", Academic Press, New York 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", Second Edition, Aspen Publication Inc. Rockville, Maryland, USA, 1990
3. Peter Berman, "Health Planning for Effective Management", Oxford University Press. 1988
4. Blane, David, Brunner, "Health and Social Organization: Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002.
5. Arnold D Kalcizony and Stephen M Shortell, "Health Care Management", Sixth Edition Cengage Learning, 2011.
6. Arnold D Kalcizony and Stephen M Shortell, "Health Care Management", Sixth Edition Cengage Learning, 2011.

Chairman
BoS/BME

20EC502	MICROPROCESSORS AND MICROCONTROLLERS (COMMON TO BME, CSE, ECE, EEE & IT)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the architecture of 8085 microprocessor and 8086 microprocessor
- Design a microcontroller based system Illustrate the Architecture of 8086 microprocessor
- Develop skills in interfacing of peripheral devices with 8086 microprocessor
- Study the architecture of 8051 and examine the design aspects of I/O Interfacing circuits
- Develop skills in interfacing 8051 and study about mixed signal microcontroller

UNIT I 8 BIT AND 16 BIT MICROPROCESSORS **9**

8085 Microprocessor: Architecture – Instruction Set – Addressing Modes – Assembly Language Programming.

8086 Microprocessor: Architecture – Addressing Modes – Instruction Set – Assembly Language Programming.

UNIT II 8086 SYSTEM BUS STRUCTURE **9**

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely Coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III PERIPHERAL INTERFACING **9**

Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT IV 8051 MICROCONTROLLER ARCHITECTURE AND PROGRAMMING **9**

Architecture of 8051 – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly Language Programming.

UNIT V INTERFACING MICROCONTROLLER AND MIXED SIGNAL MICROCONTROLLER **9**

LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface Stepper Motor, MSP430 series. Mixed Signal Microcontroller: MSB430 Series Block diagram, Addressing Modes. Instruction set.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (ECE)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Develop assembly language program to solve mathematical problems using 8 bit and 16 bit microprocessors
- Create a multiprocessor system with 8086 microprocessor
- Interface I/O and memory devices with 8086 microprocessor
- Analyze the architecture and signals of 8051 microcontroller
- Interface microcontroller and analyze the mixed signal microcontroller

TEXT BOOKS:

1. Yu-Cheng Liu and Glenn A Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Prentice Hall of India, 2nd Edition, 2011.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2nd Edition, 2011.

REFERENCES:

1. Doughlas V Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2nd Edition, 2012.
2. Senthil Kumar N, Saravanan M and Jeevananthan S, "Microprocessor and Microcontrollers", Oxford Higher Education, 2nd Edition, 2010.

CHAIRMAN
BoS (ECE)

20EC505L	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY (COMMON to BME, CSE, ECE, EEE & IT)	L T P C 0 0 3 1

OBJECTIVE:

The student should be made to:

- Introduce ALP concepts and features
- Write ALP for arithmetic and logical operations in 8086,8051 and MSP 430
- Differentiate Serial and Parallel Interface
- Interface different I/Os with Microprocessors
- Be familiar with MASM

LIST OF THE EXPERIMENTS

8086 PROGRAMS USING KITS AND MASM

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

PERIPHERALS AND INTERFACING EXPERIMENTS

1. Traffic light control
2. Stepper motor control
3. Key board and Display
4. Serial interface and Parallel interface
5. A/D and D/A interface and Waveform Generation

8051 EXPERIMENTS USING KITS

1. Basic arithmetic and Logical operations
2. Square and Cube program, Find 2's complement of a number
3. Unpacked BCD to ASCII.

MSP430 EXPERIMENTS USING KIT

1. Blinking of LED
2. Seven Segment Display
3. Keyboard
4. LCD

TOTAL: 45 PERIODS

OUTCOME:

On successful completion of this course, the students will be able to,

- Write ALP Programmes for fixed and Floating Point and Arithmetic
- Interface different I/Os with processor
- Establishing Data communication using 8086
- Execute Programs in 8051 & MSP 430
- Design & implement 8051 and MSP 430 controller based system

CHAIRMAN
BoS/ECE

28/11/22.

20BM604L DIAGNOSTIC AND THERAPEUTIC EQUIPMENT LABORATORY

L T P C
0 0 3 1

OBJECTIVES:

The student should be made to:

- Demonstrate recording and analysis of different Bio potentials
- Aware of the intricacies of Diathermy in the medical field
- Exhibit the Respiratory measurements and its significance
- Analyze the ECG, EEG and EMG signals
- Examine different therapeutic modalities

LIST OF EXPERIMENTS:

1. Measurement of visually evoked potential
2. Galvanic Skin Resistance (GSR) measurement
3. Study of shortwave and ultrasonic diathermy
4. Measurement of various physiological signals using biotelemetry
5. Study of hemodialysis model
6. Electrical safety measurements
7. Measurement of Respiratory parameters using spirometry
8. Study of medical stimulator
9. Analyze the working of ESU – cutting and coagulation modes
10. Recording of Audiogram
11. Study the working of Defibrillator and Pacemakers
12. Analysis of ECG, EEG and EMG signals
13. Study of Ventilators
14. Study of Ultrasound scanners
15. Study of Heart lung machine model

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

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

Chairman
BoS/BME

20BM605L	MINI PROJECT-II	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Identify problems and needs of the society and industries.
- Divide the complex problems into simple modules
- Identify relevant solutions by doing extensive literature survey
- Prepare a schematic diagram about the plan of execution
- Propose appropriate solutions through the modern tools and techniques

The students may choose a topic and work with due approval from Head of the Department. Students may do the Mini Project in a group. The maximum number of students in a group should not exceed 3. Every student group will be doing their project under the guidance of a Faculty member. A comprehensive Mini Project report should be prepared by each group after completing the work to the satisfaction of the Supervisor. The progress of the Mini Project will be evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. The review committee will be a two member team. The presence of Mini Project supervisor along with the review committee for the group concerned is mandatory during the review.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Determine the required solutions for the problem
- Develop strategies to break complex problems into simpler modules
- Experiment and do analysis on the empirical data arrived
- Create documentation on the experimental output and prepare presentation
- Demonstrate the project ideas to the reviewers and continues to improve the performance

CHAIRMAN
BoS (BME)

20EEC601L	EMPLOYABILITY SKILLS	L T P C 0 0 2 1

OBJECTIVES:

The student should be made to:

- Learn the application of mathematical and project management to different contexts
- Focus on quantitative ability and employability skills through modern practices
- Enhance job skills and analytical ability of students
- Improve reasoning skills and employability skills
- Practice the skills on logical reasoning and interview techniques

UNIT I INTRODUCTION TO NUMERIC ABILITY AND PROJECT MANAGEMENT **6**

Aptitude – Ratio and Proportion – Partnership – Allegation of Mixtures – Coding and Decoding - Number Sequence.

Soft Skills – Managerial Skills – Project Cost, Risk and Task Management, Conflict Management and Resolution.

UNIT II QUANTITATIVE ANALYSIS AND EMPLOYERS EXPECTATIONS **6**

Aptitude – Number System – Data Interpretation – Chain Rule – Surds and Indices – Direction Sense.

Soft Skills – Employers Needs and Expectations – Mind Mapping – Situation Reaction Test (SRT).

UNIT III ANALYTICAL SKILLS AND JOB READINESS **6**

Aptitude – Combination – Probability – Problems on Ages – Seating Arrangements.

Soft Skills – Job Application – Resume Building – Exploring and Identifying Career Options.

UNIT IV REASONING ABILITY AND INSIGHT ON INTERVIEWS **6**

Aptitude – Mensuration – SI and CI – Cause and Effect – Statement, Assumptions and Conclusions.

Soft Skills – Interview Techniques – Job Description – Roles and Responsibilities – Work Etiquettes.

UNIT V LOGICAL REASONING AND READY RECKONERS FOR INTERVIEWS **6**

Aptitude – Input – Output Tracing – Trains – Calendar – Blood Relations.

Soft Skills – Types of Interview – Interview Process -- Analyzing the Interviewer – HR Questions – Mock Interviews.

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Develop numerical ability and project management skills
- Achieve quantitative skills and employability skills
- Understand both analytical and job readiness in a productive manner
- Acquire reasoning ability and interview techniques
- Obtain logical skills and interviewers expectations

Chairman
BoS/S&H

TEXT BOOKS:

1. Aggarwal R S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing New Delhi, Revised Edition, 2017.
2. Murty G R K, "Soft Skills for Success", DGM ICFAI books, Revised Edition, 2005.

REFERENCES:

1. Abhijit Guha, "Quantitative Aptitude for All Competitive Examinations", McGraw Hill Education, Sixth Edition, 2016.
2. Carnegie Dale, "How to Win Friends and Influence People", Simon and Schuster New York, 1998.
3. Thomas A Harris, "I'm OK - You're OK", Harper and Row New York, 1972.
4. Rajesh Verma, "Fast Track Objective Arithmetic", Arihant Publications (India) Limited, 2012.
5. Arun Sharma, "How to Prepare for Quantitative Aptitude for CAT", McGraw Hill Education, Eighth Edition, 2018.

Chairman
BoS/S&H

20BM701 DIGITAL IMAGE PROCESSING

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the fundamentals of Digital images and the Transforms.
- Understand the significance of domain transformations and image enhancements
- Recognize the typical advantage of using the filters
- Acquire the required output through the process of segmentation and processing
- Study the requirements of compression and image recognition

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationship between pixels – Color image fundamentals – RGB, HSI models, Two dimensional mathematical preliminaries, 2D transforms – DFT, DCT

UNIT II IMAGE ENHANCEMENT **9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering – Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color Image Enhancement

UNIT III IMAGE RESTORATION **9**

Image Restoration – Degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band Reject Filters – Band Pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener Filtering

UNIT IV IMAGE SEGMENTATION **9**

Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing – Erosion and dilation, Segmentation by morphological watersheds – Basic concepts – Dam Construction – Watershed segmentation algorithm

UNIT V IMAGE COMPRESSION AND RECOGNITION **9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.

TOTAL: 45 PERIODS

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BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

- Identify the steps involved in Image processing and sampling
- Demonstrate the enhancement of the image quality using the appropriate filters and transformations
- Describe the different models involved in restoring the quality of images
- Explain the Morphological process, Segmentation and standards
- Discuss the types of coding involved for compressing and recognizing the images

TEXT BOOKS:

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson, Third Edition, 2010.
2. Anil K Jain, "Fundamentals of Digital Image Processing", Pearson, 2006.

REFERENCES:

1. Kenneth R Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C Gonzalez, Richard E Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc, 2011.
3. Dudgeon D E and Merserearu, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K Pratt, " Digital Image Processing", John Wiley, New York, 2002
5. Milan Sonka et al, "Image Processing, Analysis and Machine Vision", Brookes/Cole, Vikas Publishing House, Second Edition, 1999.

Chairman
BoS/BME

20BM702 REHABILITATION ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the rehabilitation concepts and Rehabilitation team members for future development and applications
- Study various principles of Rehabilitation Engineering
- Realize different types of Therapeutic Exercise Technique
- Understand the tests to assess the hearing loss, development of electronic devices to compensate for the loss and various assist devices for visually and auditory impaired
- Learn the various orthotic devices and prosthetic devices to overcome orthopedic problems

UNIT I INTRODUCTION TO REHABILITATION **9**

What is Rehabilitation-Universal Design Principles-Epidemiology of Rehabilitation, Health, Preventive Rehabilitation, Levels of prevention, Diagnosis of Disability, Functional Diagnosis, Primary and Secondary Disabilities, Goals of Rehabilitation, Socio-vocational Rehabilitation, Rehabilitation team, the role of Physiatrist, Physical Therapist, Occupational Therapist.

UNIT II PRINCIPLES OF REHABILITATION **9**

Introduction, The Human Component, Standards and Principles of Assistive Technology Assessment - Principles of Rehabilitation Engineering – Key Engineering Principles, Key Ergonomic Principles – Practice of Rehabilitation and Assistive Technology

UNIT III THERAPEUTIC EXERCISES AND TECHNIQUES **9**

Classification of Exercises, Coordination Exercises, Frenkels Exercises, Gait analyses – Pathological Gaits, Gait training, Relaxation exercises – Methods of training Relaxation, Strengthening exercises – Strength training, Types of Contraction, Mobilisation exercises, Endurance exercises.

UNIT IV MANAGEMENT OF COMMUNICATION AND VIRTUAL REALITY **9**

Impairment – Introduction to communication, Aphasia, Types of aphasia, Treatment of aphasic patient, Augmentative communication – general form of communication-types of visual aids, Hearing aids, Types of conventional hearing aid, Writing aids, Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT V ORTHOTIC, PROSTHETIC DEVICES AND RESTORATION TECHNIQUES **9**

General Orthotics, Classification of Orthotics – Functional and Regional, General principles of Orthosis, Calipers – FO, AFO, KAFP, HKAFO. Prosthetic devices: Hand and arm replacement, Body powered prosthetics; Myoelectric controlled prosthetics and externally powered limb prosthetics. Functional Electrical Stimulation systems – Restoration of hand function, Restoration of standing and walking, Hybrid Assistive Systems (HAS)

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain adequate knowledge about the needs of rehabilitations and its future development.

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- Have an in depth idea about Engineering concepts in Sensory and Motor rehabilitation.
- Apply the different types of Therapeutic Exercise Technique to benefit the society
- Design and apply different types of Hearing aids, visual aids and their application in biomedical field and hence the benefit of the society
- Gain in depth knowledge about different types of models of Hand and arm replacement

TEXT BOOKS:

1. Sunder S, "Textbook of Rehabilitation", Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, Second Edition, 2007.
2. Joseph D Bronzino, "The Biomedical Engineering Handbook", Third Edition, Four Volumes, Taylor and Francis, 2006.

REFERENCES:

1. Horia-Nicolai, L Teodorescu, Lakshmi C Jain, "Intelligent systems and technologies in Rehabilitation Engineering", CRC Press, 2000
2. Keswick J, "What is Rehabilitation Engineering, Annual Reviews of Rehabilitation, Springer Verlag, New York, 1982
3. Warren E Finn, Peter G LoPresti, " Handbook of Neuroprosthetic Methods CRC Press, 2002
4. Rory A Cooper, Hisaichi Ohnabe, Douglas A Hobson, "An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering", CRC Press, 2006.

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20BM703L DIGITAL IMAGE PROCESSING LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES:

The student should be made to:

- Practice the Basic Image Processing Techniques
- Compute Magnitude and Phasor representation of images
- Write simulation program for DFT Analysis of Images
- Understand the concepts of Restoration and Segmentation
- Explore the Applications of Image Processing Techniques

LIST OF EXPERIMENTS

1. Image Sampling and Quantization
2. Analysis of Spatial and Intensity resolution of images
3. Intensity transformation of images
4. DFT analysis of Images
5. Transforms (Walsh, Hadamard, DCT, Haar)
6. Histogram Processing and Basic Thresholding functions
7. Image Enhancement – Spatial Filtering
8. Image Enhancement – Filtering in Frequency domain
9. Image segmentation – Edge detection, Line detection and point detection
10. Basic Morphological operations.
11. Analysis of images with different color models
12. Image compression and restoration techniques

TOTAL: 30 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Perform enhancing operations on the image using spatial filters and frequency domain filters
- Use transforms and analyze the characteristics of the image
- Perform segmentation operations in the images
- Estimate the efficiency of the compression technique on the images
- Apply image processing technique to solve real health care problems

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20BM704L HOSPITAL TRAINING

L T P C
0 0 2 1

OBJECTIVES:

The student should be made to:

- Observe medical professionals at work in the wards and the roles of Allied Health professionals
- Provide access to healthcare professionals to get a better understanding of their work
- Demonstrate patient care in a hospital setting
- Enrich the importance of inter-professional relationships with health professionals
- Aware of the role to address the healthcare needs

ASSESSMENT

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

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

TOTAL: 30 PERIODS

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BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

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

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BoS/BME

20BM704L HOSPITAL TRAINING

L T P C
0 0 2 1

OBJECTIVES:

The student should be made to:

- Observe medical professionals at work in the wards and the roles of Allied Health professionals
- Provide access to healthcare professionals to get a better understanding of their work
- Demonstrate patient care in a hospital setting
- Enrich the importance of inter-professional relationships with health professionals
- Aware of the role to address the healthcare needs

ASSESSMENT

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- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

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

TOTAL: 30 PERIODS

Chairman
BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

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

Chairman
BoS/BME

20BM801L PROJECT WORK

L	T	P	C
0	0	20	10

OBJECTIVES:

The student should be made to:

- Develop the ability to solve a specific problem right from its identification
- Do the literature review to know any recent work has been carried out on the problem
- Acquire sufficient inputs for preparing project reports
- Prepare themselves for presenting the project work carried out
- Accumulate as many information as possible to face reviews, comments and implement the suggestions

The students may choose a topic and work with due approval from Head of the Department. Students may do the project in a group. The maximum number of students in a group should not exceed 3. Every student group will be doing their project under the guidance of a Faculty member. A comprehensive project report should be prepared by each group after completing the work to the satisfaction of the Supervisor. The progress of the project will be evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The review committee will be a three member team. The presence of project supervisor along with the review committee for the group concerned is mandatory during the review.

TOTAL: 300 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply all the fundamental knowledge acquired to solve problems
- Design and Develop solutions for the complex problems of the society using modern tools and ensure environmental sustainability
- Explain the identified problem with appropriate presentation and documentation
- Interpret the issues taken up with the required ethical standards and communicates to address need of the society
- Demonstrate the need for independent and lifelong learning in the broadest sense of technological change.

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BoS/BME

20BM502PE	BIOMATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn the characteristics and classification of Biomaterials
- Understand different metals, ceramics and its nano materials characteristics as biomaterials
- Learn polymeric materials and its combinations that could be used as a tissue replacement implants
- Get familiarized with the concepts of Nano Science and Technology
- Understand the concept of biocompatibility and the methods for biomaterials testing

UNIT I INTRODUCTION TO BIO-MATERIALS **9**

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

UNIT II METALLIC AND CERAMIC MATERIALS **9**

Metallic implants – Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nano structured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

UNIT III POLYMERIC IMPLANT MATERIALS **9**

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio Polymers: Collagen, Elastin and Chitin. Medical Textiles, Materials for Ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.

UNIT IV TISSUE REPLACEMENT IMPLANT **9**

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Soft tissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

UNIT V TESTING OF BIOMATERIALS **9**

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETP, gamma radiation, autoclaving, Effects of sterilization.

TOTAL: 45 PERIODS

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BoS (BME)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use
- Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
- Identify significant gap required to overcome challenges and further development in polymeric materials
- Create combinations of materials that could be used as a tissue replacement implant
- Understand the testing standards applied for biomaterials

TEXT BOOKS:

1. Sujatha V Bhatt, "Biomaterials", Second Edition, Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, Murugan Ramalingam, Sampath Kumar T S and Winston O Soboyeho, "Biomaterials: A Nano Approach", CRC Press, 2010.

REFERENCES:

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

CHAIRMAN
BoS (BME)

20BM602PE ARTIFICIAL ORGANS AND IMPLANTS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Have an overview of artificial organs and transplants
- Describe the principles of implant design with a case study
- Explain the implant design parameters and solution in use
- Study about various blood interfacing implants
- Study about soft tissue replacement and hard tissue replacement

UNIT I ARTIFICIAL ORGANS AND TRANSPLANTS **9**

Artificial Organs: Introduction, Outlook for organ replacements, Design consideration, Evaluation process.

Transplants: Overview, Immunological considerations, Blood transfusions, Individual organs – Kidney, Liver, Heart and Lung, Bone Marrow, Cornea

UNIT II PRINCIPLES OF IMPLANT DESIGN **9**

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, Scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT III IMPLANT DESIGN PARAMETERS AND ITS SOLUTION **9**

Biocompatibility, Local and Systemic effects of implants, Design specifications for tissue bonding and modulus matching, Degradation of devices, Natural and Synthetic polymers, Corrosion, Wear and Tear, Implants for Bone, Devices for nerve regeneration.

UNIT IV BLOOD INTERFACING IMPLANTS **9**

Neural and neuromuscular implants, Heart valve implants, Heart and Lung assist devices, Artificial heart, Cardiac Pacemakers, Artificial Kideny – Dialysis membrane and Artificial blood.

UNIT V IMPLANTABLE MEDICAL DEVICES AND ORGANS **9**

Gastrointestinal system, Dentistry, Maxillofacial and Craniofacial replacement, Soft tissue repair, Replacement and augmentation, recent advancement and future directions.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain adequate knowledge about artificial organs and transplants
- Get clear idea about implant design and its parameters
- Have in-depth knowledge about blood interfacing implants
- Explain different types of soft tissue replacement and hard tissue replacement
- Appreciate various implantable medical devices

TEXT BOOKS:

1. Kopff W J, Artificial Organs", John Wiley and Sons, New York, First Edition, 1976
2. Park J B, "Biomaterials Science and Engineering", Plenum Press, 1984

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REFERENCES:

1. Bronzino J D, " Biomedical Engineering Handbook", Volume II, CRC Press, 2000
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2003
3. Joon B Park, "Biomaterials – An Introduction", Plenum Press, New York, 1992
4. Yannas I V, "Tissue and Organ Regeneration in Adults", Springer, New York, 2001
5. MyerKutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill, 2003.

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BoS/BME

20BM503PE	MEDICAL OPTICS (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Study about the optical properties of the tissues and the interactions of light with tissues
- Understand the instrumentation and components in Medical Optics
- Learn about the Medical Lasers and their applications
- Have an overview of the optical diagnostic application
- Appreciate the emerging optical diagnostic and therapeutic techniques

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

Fundamental Properties of light – Refraction, Reflection, Laws (Snell's law and Fresnel law) Scattering, Absorption, Light transport inside the tissue, Tissue properties, LASER characteristics as applied to medicine and biology, LASER tissue interactions – Photo chemical, Photo thermal and Photo mechanical interactions, Fluorescence, Speckles, Photo ablative processes.

UNIT II INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, Scattering and emission measurements, Excitation light sources – high pressure arc lamps, LEDs, LASERS, Optical filters – Prism and Monochormators, Polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection.

UNIT III SURGICAL THERAPEUTIC APPLICATIONS OF LASERS 9

LASERS in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

UNIT IV NON THERMAL DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, LASER induced Fluorescence (LIF)-Imaging, FLIM Raman Spectroscopy and imaging, FLIM – Holographic and Speckle applications of LASERS in biology and medicine.

UNIT V DIAGNOSTIC AND THERAPEUTIC TECHNIQUES 9

Near field imaging of biological structures, In vitro clinical diagnostics, Phototherapy, Photodynamic therapy (PDT) – Principles and mechanisms – Oncological and non-oncological applications of PDT – Biostimulation effect – applications – LASER safety procedures.

TOTAL: 45 PERIODS

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BoS(BME)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Demonstrate knowledge of the fundamentals of optical properties of tissues
- Analyze the components of instrumentation in Medical Photonics and Configurations
- Describe surgical applications of LASERS
- Describe photonics and its diagnostic applications
- Investigate emerging techniques in medical optics

TEXT BOOKS:

1. Tuan Vo Dirh, "Biomedical Photonics – Handbook", CRC Press, Bocaraton, 2014.
2. Paras N Prasad, "Introduction to Biophotonics", A John Wiley and Sons Inc. Publications, 2003.

REFERENCES:

1. Markolf H Niemz, "LASER-Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. David Baxter G, "Therapeutic LASERS–Theory and Practice", Churchill Livingstone Publications, Edition-2001.
3. Leon Goldman, M D and James Rockwell R Jr, "LASERS in Medicine", Gordon and Breach, Science Publishers Inc., 1975.

CHAIRMAN
BoS(BME)

20BM708PE NEURAL ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Discuss the physiological concepts of nerve impulse generation and Electromyography
- Discuss about EEG and its various applications
- Explore Evoked potentials and its importance in medicine
- Introduce various techniques to study central and peripheral nerve function
- Discuss the Electrophysiological evaluation in special situations

UNIT I NERVE EXCITABILITY AND ELECTROMYOGRAPHY 9

Nerve Excitability: Functional insights derived from axonal structures, Nerve excitability findings in Neurological diseases: Chemotherapy induced neurotoxicity, Nerve Conduction studies, Clinical Electromyography (EMG), Neuromuscular Ultrasound as a compliment to the electrodiagnostic evaluation, Electrophysiologic study of Disorders of Neuromuscular Ultrasound as a compliment to the electrodiagnostic evaluation.

UNIT II ELECTROENCEPHALOGRAPHY 9

Electroencephalography (EEG): General Principles and Clinical Applications, Neonatal and Paediatric EEG, EEG Artefacts and Benign Variants, Video EEG monitoring for epilepsy, Invasive Clinical Neurophysiology in Epilepsy and movement disorders, Topographic mapping, Frequency analysis and other quantitative techniques in EEG, Intraoperative EEG monitoring during carotid endarterectomy and cardiac surgery, magnetoencephalography

UNIT III EVOKED POTENTIALS 9

Evoked Potentials and Related Techniques: Visual Evoked potentials (VEPs), Electroretinography and other diagnostic approaches to the Visual System, VEPs in infants and children, Somatosensory evoked potentials, Diagnostic and Therapeutic role of Magnetic stimulation in neurology

UNIT IV FUNCTIONAL NEURO IMAGING AND RECOGNITION 9

Historical and phsiological perspective, Function neuroimaging methods: PET and fMRI, Network Analyses, Functional neuroimaging of Attention, Visual recognition, Semantic memory, Inv Language, Episodic memory, Working memory, Cognitive aging, Neuro-psychologically impaired patients

UNIT V ELECTROPHYSIOLOGICAL EVALUATION IN SPECIAL SITUATIONS 9

Electrophysiological evaluation of sacral function: Bladder, bowel and sexual function, Vestibular laboratory testing, Polysomnographic evaluation of sleep disorders, Electrophysiologic evaluation of brain death, patients in the intensive care unit, patients with suspected neurotoxic disorders.

TOTAL: 45 PERIODS

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BoS/BME

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the physiology behind generation of nerve impulses
- Describe various techniques that are used to evaluate the functioning of central and nervous system.
- Illustrate the peripheral nervous system functioning with necessary details
- Demonstrate the Evoked potentials in the retinography
- Differentiate between a normal and abnormal signal coming from a healthy and a diseased nervous system

TEXT BOOKS:

1. Michael J Aminoff et al, "Aminoff selectrodiagnosis in Clinical Neurology", Sixth Edition, Elsevier, 2012.
2. Kim E Barette et al, Ganong's Review of Medical Physiology", Twenty third Edition, McGraw Hill New York, 2010

REFERENCES:

1. Eric R Kandel et al, "Principles of Neural Science", McGraw Hill New York, 2012
2. Cooper R, "Techniques in Clinical Neurophysiology: A Practical Manual", Elsevier, Amsterdam, The Netherlands, 2005.
3. Holodny, Andrei I, "Functional Neuroimaging: A Clinical Approach", Informa Health Care, 2008.

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20BM504PE	BIOPHOTONICS	L	T	P	C
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OBJECTIVES:

The student should be made to:

- Get familiarized with various principles of Optical Imaging systems
- Appreciate the applications of Biosensors in medicine
- Study the working principle of Flow cytometer
- Understand the importance of phototherapy in treatment of diseases
- Learn various nanoparticles and nanorods for biosensing

UNIT I BIO IMAGING **9**

Bio imaging: An introduction – Transmission Microscopy – Simple Microscope, Compound Microscope – Kohler illumination, Numerical Aperture and Resolution – Optical aberrations and different types of objectives – Phase Contrast Microscopy – Dark Field Microscopy – DICM – Fluorescence microscopy, Scanning Microscopy – Inverted and Upright Microscopes – Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography – Total Internal Reflection Fluorescence Microscopy – Near field Optical Microscopy – FLIM

UNIT II OPTICAL BIOSENSORS **9**

Biosensors: An Introduction – Principles of Optical Bio Sensing: Bio Recognition, Optical Transduction – Fluorescence Sensing – Fluorescence energy transfer sensors – Molecular beacons – Optical geometries of bio sensing – Immobilization of bio recognition elements – Fiber Optic biosensors – Planar waveguide biosensors – Evanescent wave biosensors – Interferometric biosensors – Surface Plasmon resonance biosensors.

UNIT III FLOW CYTOMETRY **9**

Basics of flow cytometry – Basic steps of flow cytometry – Components of cytometer – Optical response – Fluorochromes for flow cytometry – Data manipulation and presentation.

UNIT IV PHOTODYNAMIC THERAPY **9**

Photodynamic Therapy: Basic principles – Photosensitizers for Photodynamic therapy – Light Irradiation for photodynamic therapy: Light Source, LASER dosimetry, Light delivery – Mechanism of Photodynamic action – Two photon photodynamic therapy.

UNIT V BIONANOPHOTONICS **9**

Interface of Bioscience – Nanotechnology and Photonics – Nanochemistry – Semiconductor quantum dots for bioimaging – Metallic nanoparticles and nanorods for Biosensing – Up converting nanophores – Probes Encapsulated by biologically localized embedding (PEBBLE) nanosensors for in vitro bioanalysis – Nanoclinics for optical diagnostics and targeted therapy.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Differentiate the various principles of optical imaging systems
- Outline the various applications of Biosensors in medicine
- Analyze the working principle of flow cytometer
- Describe the importance of phototherapy in treatment of diseases
- Explain about the various nanoparticles and nanorods for biosensing

TEXT BOOKS:

1. Paras N Prasad, "Introduction to Biophotonics", John Wiley & Sons, First Edition 2003.
2. Jurgen Pop, Valery V Techin, Arthur Chiou and Stefen Heinemann, "Handbook of Biophotonics", Vol 2: Photonics for Health Care, John Wiley & Sons, First Edition, 2012.

REFERENCES:

1. Harold Sackman, Brian Wilson, Valeri Viktorovich Tuchin, S Tanev, Harold Sackman "Advances in Biophotonics", IOS Press, First Edition, 2012.
2. Paras N Prasad, "Nanophotonics", John Wiley & Sons, First Edition, 2004.

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20BM507PE **PRINCIPLES OF TISSUE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the basic concepts of cells, types, growth & differentiation.
- Understand the Fundamentals of Tissue engineering and Tissue types.
- Gain the knowledge on stem cells and its sources.
- Learn the importance of engineering methods & design in Tissue Engineering.
- Discuss about the applications of Tissue engineering in the various parts of Human.

UNIT I INTRODUCTION TO CELL BIOLOGY **9**

Cell types - Progenitor cells - Cell growth and differentiation - Cell culture: Expansion - Transfer - Storage and Characterization - Cell signalling molecules - Growth factors - Cell attachment: Differential cell adhesion, Receptor-ligand binding - Cell surface markers.

UNIT II FUNDAMENTALS OF TISSUE ENGINEERING **9**

History and scope of tissue engineering - Objectives of tissue engineering - Tissue development and Tissue exchange - Tissue organization - Tissue types: Epithelial, Connective - Vascularity and angiogenesis - Wound healing - Extra Cellular Matrix: Matrix molecules and their ligands - Tissue culture – Materials in tissue engineering.

UNIT III STEM CELLS **9**

Definition of stem cells – Types of stem cells – Differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pleuripotent stem cells.

UNIT IV ENGINEERING METHODS AND DESIGN **9**

Soft lithography - Self-assembled monolayer, Micro contact printing, Micro fluidic patterning - Laminar flow patterning - Cell interaction with Polymer scaffolds and gels - Polymer scaffolds fabrications: Electro spinning - Solvent casting and particulate leaching - Micro fabrication of cell seeded scaffolds.

UNIT V APPLICATION OF TISSUE ENGINEERING **9**

Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver - Regenerative engineering: Peripheral Nerve regeneration, Cardiac tissue regeneration, Muscle regeneration – Regulation, Commercialization and Patenting.

TOTAL :45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the various cell types, growth and differentiation.
- Illustrate the different types of Tissues and Tissues the engineering concepts.
- Apply the knowledge of ethical responsibility in the use of stem cells and gene therapy in creating Tissue engineered therapies.
- Design and develop different biomaterial in Tissue engineering application.
- Demonstrate knowledge in research or clinical application on Tissue repair engineering.

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TEXT BOOKS:

1. Robert P lanza, Robert Langer, Joseph Vacanti, "Principles of Tissue Engineering", Academic Press, United States, 2020.
2. Donglu Shi, Qing Liu, "Tissue Engineering and Nanotheranostics", World Scientific Publications, Singapore, 2018.

REFERENCES:

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

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20BM506PE GENETIC ENGINEERING: THEORY AND APPLICATION L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the Basics of Biological System and cell structure.
- Understand different cloning methodologies
- Study about the recombinant DNA technology and transformation mechanisms.
- Get familiarized with the isolation and purification of product.
- Acquire the knowledge on different characterization of isolated product and applications.

UNIT I BASICS OF BIOLOGICAL SYSTEM 9

Introduction & Basics of Biological System:Biotechnology, Need of Biotechnology-Cell Structure - Difference between Animal and Plant cells- Types of centifuges – Cell Fractionation by centifugation –Density Gradient Centrifugation -Metabolic Reactions in Biological System - Growth Media For Different Expression System -Microbial Growth Kinetics.

UNIT II BASICS OF CLONING 9

Genetically modified organisms - Isolation of a Gene Fragment approches – construction of genomic library – Isolation of a genomic DNA – Generation of Fragment – Isolation of mRNA – Homopolymer tailing – Gubber Hoffman method - DNA Replication – Primers -Polymerase Chain Reaction - Molecular Tools for Cloning - Cloning Vectors.

UNIT III RECOMBINANT DNA TECHNOLOGY 9

DNA Delivery In Host – Discovery of Transformations – Mechanism of Transformations electroporation - Chemical transfection methods - Liposome and Lipoplex transfection Bactofection -Screening of Recombinant Clones - Protein Production in Host

UNIT IV ISOLATION AND PURIFICATION OF PRODUCT 9

Product Recovery from Host Cells - Basics of Chromatography - Ion-Exchange Chromatography - Hydrophobic Interaction Chromatography - Gel Filtration Chromatography - Affinity Chromatography.

UNIT V CHARACTERIZATION OF ISOLATED PRODUCT 9

Product Characterization - Electrophoresis – Staining – SDS Page - Protein Sequencing – Spectroscopy - Biotechnology Applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the Basics of Biological System, cell structure and cell fractionation.
- Analyze the different Cloning methodologies and its processes.
- Examine the Recombinant DNA technology and transformation mechanisms
- Analyze the Isolation process and purification of product.
- Identify the different characterization of isolated product in different applications.

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TEXT BOOKS:

1. J. M. Berg, J. L. Tymoczko and L. Stryer, "Biochemistry", W. H. Freeman and Company New York, 2006.
2. D. L. Nelson and M. M. Cox, Lehninger "Principles of Biochemistry", 5th Ed Macmillan Worth, 2007.

REFERENCES:

1. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walters, "Molecular Biology of Cell", 5th Ed, Garland Publishing, 2007.
2. L. M. Prescott, J. P. Harley and D. A. Klein, "Microbiology", 6th Ed, McGraw Hill, 2005.
3. S. B. Primrose and R. M. Twyman, "Principles of Gene Manipulation", Blackwell Science, 2006.
4. Jocelyn E. Krebs, Stephen T. Kilpatrick , Elliott S. Goldstein Lewin, "Genes IX", International Edition, Pearson education, 2008.

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20BM508PE **MEDICAL DEVICE DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the Needs & Concept generation of Medical devices.
- Learn the Medical Device stanards and Requirements.
- Outline the quality assessment in the Hardware and Software Design Testing types and Validation Procedures.
- Describe about the design realization.
- Understand the Design transfer and manufacturing of Hardware and Software.

UNIT I NEEDS FINDING AND CONCEPT GENERATION **9**

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 II MEDICAL DEVICES STANDARDS AND REQUIREMENTS **9**

FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO 13485, ISO 14971, IEC 60601-1, IEC 62304. Reliability, Concept of failure, Product Design and Development Process.

UNIT III DESIGN ENGINEERING **9**

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

UNIT IV TESTING AND VALIDATION **9**

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

UNIT V DESIGN TRANSFER AND MANUFACTURING **9**

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

TOTAL :45 PERIODS

OUTCOMES:

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

- Describes the Needs & know how to generate concepts of Medical devices.
- Demonstrate the Medical Device Standards and Requirements.
- Implement the engineering Design and Project Metrics.
- Demonstrate the testing and validation of Medical equipment.
- Interpret the various design transfer and manufacturing methods.

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TEXT BOOKS:

1. Zenios, Makower and Yock, "Biodesign: The process of innovating medical technologies", 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.

REFERENCES:

1. Richard C. Fries and Marcel Dekker AG, "Handbook of Medical Device Design", 2nd edition, 2005.
2. Gail Baura, "Medical Device Technologies: A Systems Based Overview Usin 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.
4. Jagdish Chaturvedi, "Inventing medical devices: A perspective from India", Create Space Independent Publishing Platform, 1st edition, 2015.

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BoS (BME)

20BM710PE HEALTHCARE PRODUCT DEVELOPMENT **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Appreciate the global trends and development methodologies of various types of healthcare products and services
- Study the history and role of regulation in clinical research
- Knowthe requirement of engineering and understand how to collect, analyze a new product development
- Have insights in the drug discovery and human trials
- Understand market strategy in converting a design into a product

UNIT I PRODUCT CYCLE FOR MEDICAL DEVICES **9**

Introduction – FDA total product life cycle – European commission product life cycle – Product life cycle management, current good manufacturing practices, End User purchasing stakeholders, Operational Assist Management – Medical device integration into existing workflow – Managing risk in healthcare technology, Existing point of care protocols. Engineering assessment of Medical device failure

UNIT II REGULATORY PROCESS IN CLINICAL RESEARCH **9**

History and role of regulations in clinical research, Indian Regulatory laws, Schedule Y, Registration of new drugs, Requirements of registration, Regulatory environment and practices, US regulatory system, EU regulatory affairs, Non-disclosure agreement, GMP regulations, Patent and Patent laws

UNIT III DRUG DISCOVERY **9**

Drug design – Ligand based, Structure based, Active site identification, Rational drug discovery, High throughput screening, Structure Activity Relationship (SAR), Quantitative Structure Activity Relationship (QSAR), Computer Assisted Drug Designing (CADD)

Terminology in Clinical Research, Preclinical phases, First in Human Trials, Single Ascending Dose and Multiple Ascending Dose Studies, Exploratory Clinical Trials, Confirmatory Clinical Trials, Post marketing surveillance

UNIT IV TESTING AND VALIDATION **9**

Introduction to Biostatistics, Statistical analysis for product and design validation, Clinical trials, Calibration, Challenges in biomedical research, Case study on launch of new biomedical device

UNIT V BUSINESS DYNAMICS ENGINEERING SERVICES INDUSTRY **9**

The industry – Engineering Services Industry – Product development in industry versus Academia – The IPD Essentials – Introduction to vertical specific product development processes – Manufacturing / Purchase and Assembly of Systems – Integration of Mechanical, Embedded and S/W systems – Product development Trade-Offs – Intellectual Property Rights and Confidentiality – Security and configuration management

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Propose a new biomedical product and explain the clinical need
- Solve specific problems independently with necessary regulatory and safety norms
- Device equipment for drug manufacturing and testing
- Develop documentation, test specifications and coordinate with various teams for validation and testing
- Know the market requirement and customize the product

TEXT BOOKS:

1. Beth Ann Fiedler, "Managing Medical Devices with a regulatory framework", Elsevier, 2017
2. Benjamin Blass, "Basic Principles of Drug Discovery and Development", First Edition, Elsevier

REFERENCES:

1. Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, New Delhi, 2005.
2. Ira R Berry, "The Pharmaceutical Regulatory Process (Drugs and the Pharmaceutical Sciences), First Edition, Informa Health Care, 2004.
3. Ezekiel J Emanuel, "Ethical and Regulatory Aspects of Clinical Research: Readings and Commentary, First Edition, The Johns Hopkins University Press, 2003

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20ME709PE	RAPID MANUFACTURING (COMMON TO MECH AND BME)	L T P C 3 0 0 3

OBJECTIVES:

The Students should be made to:

- Know the fundamentals for rapid manufacturing
- Recognize the concepts of reverse engineering and 3D printing technologies
- Familiarize with polymerization and powder based rapid manufacturing systems
- Provide knowledge on liquid based and sheet stacking processes
- Understand the concept of rapid product development and processes

UNIT I INTRODUCTION 9

Additive manufacturing – rapid prototyping – functional prototyping – Rapid Manufacturing (RM) – rapid tooling - indirect and direct manufacturing - benefits of rapid manufacturing - effectiveness of rapid manufacturing – rapid manufacturing versus CNC machining – features – materials for RM processes – properties – functionally graded materials – defects in RM parts - post processing concerns - product costing for rapid manufacturing.

UNIT II REVERSE ENGINEERING AND 3D PRINTING 9

Introduction – definition – importance – applications – process - 3D scanning process - 3D measurements - Coordinate Measuring Machine (CMM) - universal CMM Controller - laboratory demonstration on using CMM.

3D printing - technology, advantages, technical challenges – droplet formation technologies – printing process modeling – material modifications – binder printing – fusion deposition modeling - beam deposition process - material delivery - wire feeding - beam deposition systems – process parameters – processing – structure – properties relationship – benefits and drawbacks.

UNIT III POLYMERIZATION AND POWDER BASED PROCESSES 9

Photopolymerization – Photopolymerization materials - reaction rates – stereolithography process (SL) – overview, machines, scan patterns - vector scan microstereolithography - mask projection photopolymerization - two photon stereolithography – Selective Laser Sintering (SLS) - SLS process description - solid state sintering - chemically induced sintering – approaches to metal and ceramic part creation – liquid phase sintering – distinct binder and structural materials – full melting.

UNIT IV LIQUID BASED AND SHEET STACKING PROCESSES 9

Introduction – basic principles – plotting and path control – materials – limitations of Fused Deposition Modeling (FDM) – bio extrusion.

Sheet stacking processes - introduction – gluing or adhesive bonding – thermal bonding – processes based on sheet metal clamping – ultrasonic consolidation – process parameters and process optimization – properties.

UNIT V RAPID PRODUCT DEVELOPMENT AND PROCESSES 9

Introduction – characteristics – evolution of product development – sequential product development – stages in generic product development process – design specifications in the process – conceptual and detailed design – design for modularity – feature based design –

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exploring design freedoms – geometric modeling – Bezier curves – B-Splines – constraint based modeling – wireframe modeling – types of solid modeling – constructive solid geometry – feature recognition and design – simulating reality 3D print with FEA – factory for Rapid Product Development (RPD) – product life cycle management – plant simulation software – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the fundamentals of rapid manufacturing techniques
- Apply reverse engineering techniques in rapid manufacturing
- Identify various techniques of powder based rapid manufacturing systems
- Illustrate different types of liquid and sheet stacking based rapid manufacturing systems
- Use appropriate methods and processes for rapid product development

TEXT BOOKS:

1. Kamrani A K and Nasr E A, "Engineering design and rapid prototyping", Springer US, 2nd Edition, 2015.
2. Andreas Gebhardt, "Understanding Additive Manufacturing", Hanser Publications, 2012.

REFERENCES:

1. Neil Hopkinson, Philip Dickens and Richard Hague, "Rapid Manufacturing - An industrial revolution for the digital age", John Wiley and Sons, 1st Edition, 2006.
2. Gibson I, Rosen DW and Stucker, "Additive manufacturing technologies (Vol. 17)", Springer, 2014.
3. Pham D T and Dimov S S, "Rapid Manufacturing - The Technologies and Applications of Rapid Prototyping and Rapid Tooling", Springer Science & Business Media, 4th Edition, 2012.
4. Chua C K, Leong K F and Lim C S, "Rapid Prototyping: Principles and Applications", World Scientific, 3rd Edition, 2010.

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BoS (MECH)

20BM609PE **MEDICAL DEVICE REGULATIONS** **L T P C**
3 0 0 3

OBJECTIVES:

The objective of this course is to enable the student to

- Study the regulation of medical devices, process of development, ethical and quality considerations.
- Learn the various ISO standards of quality and risk management for regulatory purposes
- Explore the process of approval and marketing of medical devices.
- Comprehend the regulatory process for medical devices in India, US, and EU.
- Familiarize with clinical evaluation and investigation of medical devices.

UNIT I MEDICAL DEVICE REGULATIONS **9**

History of Medical Device Regulation, Regulatory Affairs professional's Roles, Required Competencies, Medical Device Classification: scope, definitions, main classifications, Risk based classification, practical examples, labeling of medical devices: definition, elements, risk management, clinical evaluation and labeling, language level and intended users. differentiating medical devices IVDs and combination products from that of pharmaceuticals.

UNIT II ISO STANDARDS **9**

ISO 13485:2016: Requirements for regulatory purposes: Quality Management Systems, certification process. ISO 14971: Application of Risk management to medical Devices.

UNIT III IEC, REGULATORY SYSTEMS IN USA AND EU **9**

IEC international standards and conformity assessment for medical devices, Good submission process, medical device regulatory system in the USA and European Union.

UNIT IV INDIAN REGULATORY SYSTEM **9**

India: Medical device regulatory system: market environment, functions undertaken by DGGI, central government, FDA and state governments, guidance documents, details of key regulators, IMDRF and CDSCO, regulatory overview in India, product registration on conformity assessment, quality system regulation, technical material and labeling requirements, commercial aspects, upcoming regulation changes.

UNIT V CLINICAL TRIALS AND DIGITAL REGULATIONS **9**

Regulatory strategy and competitive advantage, Preclinical and Clinical Trial Design for Medical Devices in India; FDA approved devices, post-market surveillance/vigilance, Digital health regulations: Connected care, intelligent design control, reducing design time and cost with in silicon clinical trials

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student should be able to:

- Explain the basic concepts of medical device regulations, Labeling of Medical Devices
- Assimilate the meaning of ISO standards from a regulatory perspective
- Describe US-FDA, IEC and European regulations
- Discuss Medical device regulatory system in Products, Materials & Labeling
- Explain the regulatory aspects of clinical trials and digital regulations

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TEXTBOOKS:

1. Jack Wong, Raymond Tong, "Medical Regulatory Affairs: An International Handbook for Medical Devices and Healthcare Products", 3rd Edition, Taylor & Francis Group, 2021.

REFERENCES:

1. Richard Fries "Reliable Design of Medical Devices", 2nd Edition, CRC Press, 2006.
2. Richard C Fries "Medical Device Quality Assurance and Regulatory Compliance", CRC Press, 1998.
3. Gabor Zoltan, Attila Gusty, Ralf Wilde, "Product Safety in the European Union" TUV Rheinland Akademia, 2008.

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20BM610PE MEDICAL INNOVATION AND ENTREPRENEURSHIP L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the role of creativity, Innovation & IPR
- Study the functions and scope for biomedical engineering entrepreneurship
- Understand the developing an effective business model and organization.
- Illustatre the various future investment options and globalization
- Discuss about the marketing process and research for the New Venture

UNIT I CREATIVITY, INNOVATION AND IPR 9

The Role of Creativity – The Innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process, Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

UNIT II SCOPE FOR BIOMEDICAL ENGINEERING ENTREPRENEURSHIP 9

Definition– Characteristics and functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in Medical devices. Case study.

UNIT III NEW VENTURE 9

Developing an Effective Business Model: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization:Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. case study.

UNIT IV FINANCING THE NEW VENTURE AND GLOBALIZATION 9

Evaluating Various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies, collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.

UNIT V MARKETING FUNCTION 9

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.

TOTAL :45 PERIODS

OUTCOMES:

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

- Describe the role of biomedical engineers in entrepreneurship and new ideas
- Interpret the background for biomedical engineers in entrepreneurship
- Acquire the skills and techniques required towards the business model and organization

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- Categorize the resources and funding agencies and judge the right product based on market needs
- Analyze the marketing process and research for the new ventures

TEXT BOOKS:

1. Jen-Shih Lee "Biomedical Engineering Entrepreneurship", World Scientific Publishing, USA.2010
2. Vasant Desai, "The Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 2010.

REFERENCES:

1. Brant Cooper, Patrick Vlaskovits, "The Lean Entrepreneur", Wiley, 2nd edition, New Jersy,2016.
2. Nathan Furr, Jeff Dyer, "The Innovator's Method: Bringing the Lean Start-up into YourOrganzization", Harvard Business Press, Boston, 2014.
3. Donald F.Kuratko and Richard M. Hodgetts, "Entrepreneurship", South-Western.
4. Gupta S.L., Arun Mittal, "Entrepreneurship Development", International Book House, 2012.
5. Prasanna Chandra, "Projects- Planning, Analysis, Financing, Implementation and review", TATA McGraw Hill, 2012.
6. Sudha G. S., "Management and Entrepreneurship Development", Indus Valley Publication, 2009.

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20BM804PE MACHINE LEARNING TECHNIQUES IN MEDICINE **L T P C 3 0 0 3**

OBJECTIVES:

The student should be made to:

- Explain the history, algorithm types, languages for machine learning
- Describe machine learning cycle with different data parameters
- Outline the decision tress and Bayesian Networks
- Investigate the knowledge of machine learning in radiotherapy
- Summarize the methods to detect, classify and measure objects in hematological cytology

UNIT I MACHINE LEARNING BASICS **9**

Introduction – What is learning, History of Machine Learning, Algorithm and Types of Machine Learning, The Human touch, Use of Machine Learning, Languages of Machine Learning

UNIT II PLANNING FOR MACHINE LEARNING **9**

Machine Learning Cycle, Defining the Process, Building a data team, Data Processing, Data Storage, Data Privacy, Data quality and cleaning

UNIT III WORKING WITH DECISION TREES AND BAYESIAN NETWORKS **9**

Basics of Decision tress, Uses, Advantages and Limitations, Different Algorithm Types and working of decision tress, Bayesian networks – Little graph theory, Little Probability theory

UNIT IV MACHINE LEARNING DELIVERY AND MOTION MANAGEMENT IN RADIOTHERAPY **9**

Method to estimate and compensate breathing motion during radiation therapy, Image based motion correction, Detection and Prediction Radiotherapy errors, and Treatment delivery validation – Recent advancements in radiotherapy application through machine learning

UNIT V HEMATOLOGICAL CYTOLOGY APPLICATIONS THROUGH MACHINE LEARNING **9**

Automatic analysis of microscopic images in hematological cytology applications, Methods to detect, Classify and measure objects in Hematological cytology, fully automated blood smear analysis system, Recent advances of main automated analysis, Steps in hematological cytology applications

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Appreciate the fundamentals of Machine Learning and its associate Algorithms
- Design and Plan the process of Machine Learning structures
- Exploit the decision tress significance in the Learning Algorithms
- Utilize ML techniques to deliver and manage breathing motion and compute errors
- Appraise Haematological Cytology Applications in ML

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TEXT BOOKS:

1. Issam E I Naqa, "Machine Learning in Radiation Oncology – Theory and Applications", Springer, First Edition, 2015.
2. Jason Bell, "Machine Learning for Big Data: Hands on for Developers and Technical Professionals", John Wiley and Sons, First Edition, 2014

RERFERENCES:

1. Kenneth R Foster, Robert Koprowski, Joseph D Skufca, " Machine Learning, Medical Diagnosis and Biomedical Engineering Research – Commentary", Journal of Biomedical Engineering, 2014
2. Koprowski R, Zielenznik W, Wrobel Z, Malyszek J, Stepien B, Wojcik W, "Assessment of significance of features acquired from thyroid ultrasonograms in Hashimoto's disease", Journal of Biomedical Engineering, Vol 11, 2012
3. David A, Rubenstein, Wei Yin, Mary D Frame, "Machine Learning and Data mining: Introduction to Principles and Algorithms", Horwood Publishing Limited, First Edition, 2007
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, First Edition, 2007
5. Cyran K A, Kawulok J, Kawulok M, Stawarz M, Michalak M, Pietrowska M, Polanska J, "Support Vector Machines in Biomedical and Biometrical Applications. In Emerging Paradigms in Medicine Learning", Vol 13, Springer, 2013

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20BM805PE MEDICAL RADIATION SAFETY **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the concepts of radiation and its characteristics
- Describe mechanisms of different types of biological effects following exposure to radiation
- Familiarize different types of radiation protection in nuclear medicine and oncology
- Explain radiation protection in diagnostic radiology
- Understand the concepts of radiation Hazards and Protective measures in medical diagnosis

UNIT I RADIATION BASICS **9**

Atomic structure, Characteristics of radiations, Types of Ionizing and Non – Ionizing radiations, Radioactive decay constant – Half life period, Units of Radiation and Radioactivity, Units of Radiation Risk, Relative Biological Effectiveness (RBE), Motion of Electron in a crossed Electric and Magnetic Fields, Nuclear Forces, Nuclear Model, Radiation shielding principles, Use of Pocket dosimeters

UNIT II BIOLOGICAL EFFECTS **9**

Acute biological effects of Ionizing radiations, Long term biological effects of ionizing radiations, Typical radiation doses – Background, Medicine and Industry, Dose limits for occupationally exposed individuals, Techniques for limiting radiation doses to personnel, Spontaneous mutation rate, Effect of Radiation on skin and blood forming organs, Digestive tract– Sterility and cataract formation, Effects of chronic exposure to radiation.

UNIT III RADIATION PROTECTION IN NUCLEAR MEDICINE AND ONCOLOGY **9**

Nuclear medicine, Diagnostic and Therapeutic Nuclear medicine, Positron Emission Tomography (PET), Special considerations for handling PET, Intensity modulated radiation therapy, Facility Design, Radiation Protection of Nuclear Medicine Staff, Radiation oncology, External Beam Shielding, Brachytherapy - Low Dose Rate Brachytherapy, Radiation Hazards in Brachytherapy departments and Teletherapy departments and Radioisotope Laboratories – Particle accelerators.

UNIT IV RADIATION PROTECTION IN DIAGNOSTIC RADIOLOGY **9**

Definition of Free radicals and G-Value, Kinetics of Radiation, Chemical transformations, LET and Dose Rate effects, Safety Assessment, Facility Design and Shielding – BIR Shielding method, Teletherapy machines: Reference conditions for measurement, Types of Chambers, Phantom and Waterproof Sleeve, Unintended and Accidental medical exposures, Pregnancy procedures- Magnetic Resonance Imaging safety issues, Derivation of an expression for machine timing error, Procedure for evaluation of temperature and pressure correction.

UNIT V RADIATION HAZARDS AND PROTECTIVE MEASURES **9**

Planning of Medical radiation installations – General considerations, Design of Diagnostic Deep Therapy, Telegamma and Accelerator installations, Evaluation of Radiation Hazards in Medical Diagnostic and Therapeutic installations, Radiation monitoring procedures,

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Protective measures to reduce radiation The role of recommendations and regulations, Waste disposal facilities, Radiation safety during source transfer operations.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Illustrate radiation and its characteristics to the needed application
- Give a detailed overview of the biological effects of various radiation effects
- Discuss the safety measures to be taken while administering nuclear medicine in oncology
- Consider radiation protection in diagnostic radiology with utmost higher priority
- Show what are all the radiation hazards and protective measures

TEXT BOOKS:

1. Mary Alice StatkiewiczSherer, Paul J Visconti, RusselRitenour E, Kelli Haynes, "Radiation Protection in Medical Radiography", CRC Press, Seventh Edition, 2008
2. Richard J, Vetter Magdalena, Stoeva S, "Radiation Protection in Medical Imaging and Radiation Oncology", CRC Press, First Edition, 2016
3. Gopal B Saha, "Physics and Radiobiology of Nuclear Medicine", Springer, Third Edition, 2006.

REFERENCE BOOKS:

1. Max H Lombardi, "Radiation safety in Nuclear Medicine", CRC Press, Second Edition, 2007
2. Daniel Farb, Bruce Gordan, "Occupational Radiation Safety Guidebook", University of Health Care, 2005
3. Robert J Emery and Janelle Rios, "Operational Radiation Safety", Vol. 110, No.2, 2016
4. B H Brown, Lawford P V, Small wood R H, Hose D R, Barber D C, " Medical Physics and Biomedical Engineering", CRC Press, 1999
5. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards,IAEA Standards. http://www pub.iaea.org/MTCD/publications/PDF/Pub1578_web-57265295.pdf

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20BM605PE DRUG DELIVERY PRINCIPLES AND ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the fundamental principles of Drug delivery and systems of controlled drug release
- Study the properties and characteristics of Natural and Synthetic Biopolymers
- Understand the principles and functions of diffusion and reservoir systems
- Recognize the Metal and Polymeric Particles, its effects, elasticity and size calculation
- Distinguish between various drug delivery methods and appreciate the significance of each

UNIT-I PRINCIPLES OF CONTROLLED DRUG RELEASE **9**

Fundamental Principle-Conventional Drug delivery-Pharmacokinetics: Bioavailability-Elimination-Therapeutic Index – Pro-drugs-Controlled release-Systems for achieving Controlled drug release.

UNIT-II BIOPOLYMERS **9**

Polymers:Synthesis – Properties – Characterization-Crystallinity and Amorphousness-Biopolymers:Natural and Synthetic – Bio-compatibility – Bio-degradation-Commonly used Biopolymer

UNIT-III DIFFUSION CONTROLLED SYSTEMS **9**

Principles-Diffusion Controlled Systems–Fick's laws-Reservoir Systems-Non-erodible matrix systems-Bio erodible Systems Hydro-gels: Physical or Chemical, Pore-Size Calculation-in-situ crosslinking

UNIT-IV TISSUE ENGINEERING **9**

Nano and Micro-Particles:Dendrimers-Liposomes-Micelles-Metal and Polymeric Particles – Effect of Particle Shape-Charge and Elasticity-Protein Adsorption in Tissue Engineering-Drug Delivery in Tissue Engineering.

UNIT-V DRUG DELIVERY **9**

Implanted Associated Infections-Route Specific Delivery:Oral Subcutaneous-Intramuscular-Transdermal-Inhalation-Intravenous-Cell and Gene Delivery-Smart Responsive Drug Delivery-Targeted drug delivery.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain about the drug delivery methods and understand the significance of controlled drug release
- Appreciate the difference between Natural and Synthetic Biopolymers
- Describe the principles and the functions of Reservoir systems
- Analyse the Metal and polymeric particles and explain the properties of elasticity and calculate the performance measure
- Apply and Validate the various drug delivery methods to check which is suitable for the intended application

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TEXT BOOKS:

1. Michael E A, "Pharmaceutics, Design and Manufacture of Medicines", Churchill Livingstone, Fourth Edition, 2013
2. Lloyd V Allen, "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems", Wolters Kluwer India Pvt Limited, Eleventh Edition, 2018.

REFERENCES:

1. Coelho H, "Drug Delivery Systems: Advanced Technologies Potentially Applicable in Personalized Treatment", Springer, 2013.
2. Hillary A M, Lloyd A W, Swarbrick J, "Drug Delivery and Targeting: For Pharmacists and Pharmaceutical Scientists", CRC Press, 2008.

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20BM707PE HOSPITAL WASTE MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the Hazardous materials used in hospital and its impact on health
- Know the control strategies during accidents
- Overview about the Hazardous materials used in hospitals
- Learn the Safety facilities needed in a Health care unit
- Understand various waste disposal procedures and management

UNIT I HEALTHCARE HAZARDS CONTROL AND UNDERSTANDING 9

Health care Hazard Control: Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviors, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis.

UNIT II BIOMEDICAL WASTE MANAGEMENT 9

Biomedical Waste Management: Types of wastes, Major and Minor sources of biomedical waste, Categories and classification of biomedical waste, Hazard of Biomedical waste, Need for disposal of Biomedical waste, Waste minimization, Waste segregation and labeling, Waste handling, Collection, Storage and Transportation, Treatment and disposal

UNIT III HAZARDOUS MATERIALS 9

Hazardous Materials: Hazardous Substance Safety, OSHA Hazard Communication standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection

UNIT IV FACILITY SAFETY 9

Facility Safety: Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating and Air Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety

UNIT V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY 9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare Associated Infections, Medication Safety

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Analyze various Hazards, Accidents and its control

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- Design waste disposal procedures for different Bio-wastes
- Categorise different Bio-wastes based on its properties
- Design different safety facility in Hospitals
- Propose various regulations and safety norms

TEXT BOOKS:

1. Tweedy James J, "Healthcare Hazard control and safety management", CRC Press, 2014.
2. Anantpreet Singh, SukhjitKaur, "Biomedical Waste Disposal", Jaypee Brothers Medical Publishers Limited, 2012.

REFERENCES:

1. Goyal R C, "Hospital Administration and Human Resource Mangament", Prentice Hall of India, Fourth Edition, 2006.
2. Landrum V J, "Medical Waste Management and Disposal", Elsevier, 1991.

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20BM801PE ELECTRICAL SAFETY AND QUALITY ASSURANCE L T P C
(Common to BME and ECE) 3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the concepts of Electrical Hazards along with its various types
- Have sufficient exposure to the different standards and requirements to be followed in a hospital environment
- Know the methods of Electrical protection and maintenance
- Acquire the required knowledge on standards of Quality Medical care
- Gain the necessary skills on the regulatory requirements in health care

UNIT I ELECTRICAL HAZARDS 9

Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation – Current surges – Electrical causes of fire and explosion Human interface with electricity, Human resistance to electricity

UNIT II STANDARDS AND REQUIREMENTS 9

National electrical safety code – Standards and statutory requirements – Indian electrical acts and rules – statutory requirements from Electrical inspectorate, Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards)

UNIT III ELECTRICAL PROTECTION AND MAINTENANCE 9

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools – Preventive maintenance, First aid- cardio pulmonary resuscitation (CPR)

UNIT IV STANDARD OF QUALITY MEDICAL CARE IN HOSPITALS 9

Define Quality – Need for Standardization and Quality Management, QM in Health care organization – Quality assurance methods, QA in (Medical Imaging and Nuclear medicine) Diagnostic services – Classification of equipments

UNIT V REQULATORY REQUIREMENT FOR HEALTH CARE 9

CE and FDA regulations, Accreditation for Hospitals – JCI, NABH and NABL, Other regulatory codes.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Differentiate the types of Electrical Hazards, cause and reasons of it
- Review the necessary Standards and Requirements when planning Electrical connections in Hospitals
- Plan the Health care environment with sufficient Electrical Protection and the ways of maintenance
- Appreciate the standards of quality medical care in a Hospital
- Follow the regulatory requirements while installing Medical equipments

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TEXT BOOKS:

1. Shakharkar B M, Principles of Hospital Administration and Planning", Jaypee Brothers, Medical Publishers (P) Limited
2. Shridhara Bhat, "Quality Management", Himalaya Publishing House Cesar A Cacere and Albert Zana, The Practice of Clinical Engineering, Academic Press, New York, 1977

REFERENCES:

1. Webster J G and Albert M Cook, "Clinical Engineering, Principles and Practices", Prentice Hall Inc., Englewood Cliffs, New Jersy, 1979
2. Karen Parsley, Karen Parsley Philomena Corrigan, Quality Improvement in Healthcare", Second Edition, Nelson Thrones Publications, 2002
3. Sharon Myers, " Patient Safety and Hospital Accreditation – A Model for Ensuring Success" Springer Publishers 2012

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BoS/BME

20BM714PE **FORENSIC SCIENCE IN HEALTHCARE** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the history of forensic sciences and concepts of quality control management
- Identify the roles of different types of professionals involved in evaluating a crime scene and the Evidence collection
- Understand the Forensic microscope and Anthropology
- Apply the Blood stain identification
- Learn the methodology of collecting & interpreting data for fingerprint application

UNIT I BASICS OF FORENSIC SCIENCE **9**

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.

UNIT- II OBSERVATION AND CRIME SCENE **9**

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 III FORENSIC MICROSCOPE AND ANTHROPOLOGY **9**

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 IV BLOOD STAIN IDENTIFICATION **9**

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.

UNIT V FINGERPRINT APPLICATION **9**

Fingerprints -Fundamental Principles of Fingerprint Analysis, Classification of Fingerprints, Collection of Fingerprint Evidence, Automated Fingerprint Identification Systems (AFIS), Track marks, Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Define the significance of forensic sciences
- Observe and document crime scenes
- Determine Trauma and Diseases.
- Describe the various sources of medical data related to forensic science.
- Demonstrate the visual analytical procedure of finger print application.

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TEXT BOOKS:

1. Nanda, B.B. and Tewari, R.K, "Forensic Science in India: A vision for the twenty first century", Select 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:

1. "Saferstein : Criminalistics", Prentice Hall Inc., USA, 1976.
2. Peter Deforest, Robert Gaensslen, Henry Lee, "Forensic Science: An Introduction to Criminalistics" Tata McGraw-Hill, 1983.
3. Sharma, B.R, "Forensic Science in Criminal Investigation and Trials", Central Law Agency, Allahabad, 1974.

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BoS (BME)

20BM715PE ECONOMICS AND MANAGEMENT FOR ENGINEERS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the Nature, law & Scope of Economics
- Understand the concepts of Economics with respect to the demand and supply analysis.
- Analyze the theory of production and the analysis of the cost parameter
- Explore the concept of management and its approach
- Manage and plan the situation with the help of the available strategies to support the decision making process.

UNIT I INTRODUCTION TO ECONOMICS 9

Introduction to Economics – Nature of Managerial 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 II DEMAND AND SUPPLY ANALYSIS 9

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 III THEORY OF PRODUCTION AND ANALYSIS OF COST 9

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 IV INTRODUCTION TO MANAGEMENT 9

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

UNIT V PLANNING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Summarize how to use economics principles to solve economic problems in engineering discipline by satisfying the economic laws
- Discuss the demand and supply process for a market analysis using Price elasticity, Cross elasticity and Income elasticity
- Interpret short run and long run costs in the process of production for carrying out a business

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- Apply managerial skills to make decisions and solve problems for achieving organizational objectives
- Express the principles of effective planning for survival and success of all organizations using strategic planning & decision making

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. Ranbir Singh, "Principles of Engineering Economics and Management", S.K.Kataria & Sons, New Delhi, 2013.
2. Manish Varshney and Vidhan Banerjee, "Engineering and Managerial Economics", 1st Edition, CBS Publishers and Distributors Pvt. Ltd., 2015.

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20BM716PE **BIOSTATISTICS** **L T P C**
2 0 2 3

OBJECTIVES:

The student should be made to:

- Understand the statistical informer methods and Analysis
- Comprehend the fundamentals of mathematical and statistical theory in the biomedical field
- Apply the regression and correlation analysis in the physiological data
- Understand the source of Medical data & applying in community health
- Understand the Meta Analysis of Healthcare data

UNIT I INTRODUCTION **6**

Introduction, Some basic concepts, Measurement and Measurement Scales, Sampling and Statistical Inference, The Scientific Method and the Design of Experiments Computers and Biostatistical Analysis.

UNIT II PROBABILITY DISTRIBUTIONS **6**

Probability Distributions of Discrete Variables, Binomial Distribution, Poisson Distribution Continuous Probability Distributions, Normal Distribution, Normal Distribution Applications

UNIT III REGRESSION AND CORRELATION ANALYSIS **6**

Introduction, regression model, sample regression equation, evaluating the regression equation, using the regression equation, correlation model, correlation coefficient.

UNIT IV INTERPRETING DATA **6**

Interpreting life tables clinical trials, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V ANALYSIS OF VARIANCE **6**

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

30 PERIODS

LAB COMPONENT

Students need to use appropriate software tools to implement the following,

1. Identify quantitative, ordinal, and categorical measurements from the data
2. Construct and interpret stem plots and histograms,
3. Construct and interpret frequency tables, calculate and interpret means, standard deviations, medians, and quartiles
4. Calculate and interpret Normal probabilities and values.
5. Calculate and interpret confidence intervals for means

30 PERIODS

TOTAL: 60 PERIODS

OUTCOMES:

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

- Define the new and existing statistical methodology for their research problem
- Explain the values for different statistical tests
- Analyze the biomedical research data and be able to report the study results

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- Describe the various sources of medical data
- Demonstrate the meta Analysis of Healthcare

TEXT BOOKS:

1. Wayne W. Daniel, "Biostatistics - A Foundation for Analysis in the Health Sciences", John Wiley & Sons Publication, 10th Edition, 2013.
2. Peter Armotage, Geoffrey Berry and J.N.S.Mathews, "Statistical methods in Medical Research", Wiley-Blackwell, 4th Edition, 2001.
3. Bernard Rosner, "Fundamentals of biostatistics". Nelson Education, 8th Edition, 2015.
4. Chandan K. Reddy, Charu C. Agarwal, "Healthcare Data Analytics", CRC Press, 2015.

REFERENCES:

1. Marcello Pagano and Kimberlee Gauvreu, "Principles of Biostatistics", Chapman and Hall/CRC, 2nd Edition, 2018.
2. Ronald N Forthofer and EunSul Lee, "Introduction to Biostatistics", Academic Press, 1st Edition, 2014.
3. Animesh K. Dutta, "Basic Biostatistics and its Applications", New Central Book Agency, 1st Edition, 2006.

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20BM717PE **CLINICAL ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understanding of the clinical engineering profession, qualifications, roles, activities, and expectations
- Enhance to practice medical equipment and analyze challenges with their healthcare technology
- Engage to work as a team to address problems and errors in medical devices
- Design better medical devices with computerized approaches
- Explore the Health Technology Management systems with medical devices and supportive services with advanced application

UNIT I INTRODUCTION **9**

Clinical engineering: Definition, Evolution, Roles, Responsibilities, Functional status, History of clinical engineering and Technology in Health Care System, Enhancing patient safety.

UNIT II MEDICAL TECHNOLOGY MANAGEMENT PRACTICES **9**

Strategic Medical Technology Planning, Scope , Clinical necessity operational support, strategic planning process – Technology assessment: Technology audit, Budget strategies, Prerequisite for medical technology assessment – Management Practice for Medical Equipment - Device evaluation, Risk reduction, Asset management, ESHTA.

UNIT III ESSENTIAL HEALTH CARE TECHNOLOGY PACKAGE (EHTP) **9**

Introduction – Health care technology management – Package development: Methodology, Logical framework, Implementation, Information promotion and dissemination – EHTP Justification – EHTP matrix – EHTP advantages – Impact Analysis.

UNIT IV CLINICAL ENGINEERING PROGRAM INDICATOR **9**

Clinical engineering: program services, Program database – Clinical Engineering Program management, Program indicator, Managing clinical engineering performance using program indicators – Indicator management process.

UNIT V ADVANCED TECHNOLOGY FOR PATIENT SAFETY **9**

Factors Contributing to Medical Errors: Heath Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA), Patient Safety Best Practices Model: Bar coding, Computerized Physician Order Entry (CPOE), and Clinical data repositories – Process analysis, Methodology. Computerized medical equipment management systems. Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- State the role of clinical engineers and discuss the basic concepts of medical and healthcare technology
- Give the program and framework to recognize the errors of medical equipment
- State the issues or errors in patient safety and formulate patient safety package system

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- Define the problem precisely and examine the possible issues using program indicators
- Demonstrate computer based equipment with automated system by using CPOE method

TEXT BOOKS:

1. Ernesto Iadanza, Joseph Dyro, "Clinical Engineering Handbook", Elsevier Academic Press, 2014.
2. Robert Miniati, "Clinical Engineering from Devices to Systems", Academic Press, 2015 - Technology & Engineering.

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20BM712PE **MANAGEMENT INFORMATION SYSTEM** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

The student should be made to:

- Describe the role of information technology and decision support systems in business and record the current issues with those of the firm to solve business problems.
- Introduce the fundamental principles of computer-based information systems analysis and design and develop an understanding of the principles and techniques used.
- Enable students understand the various knowledge representation methods and different expert system structures as strategic weapons to counter the threats to business and make business more competitive.
- Enable the students to use information to assess the impact of the Internet and Internet Technology on electronic commerce and electronic business and understand the specific threat sand vulnerabilities of computer systems.
- Provide the theoretical models used in database management systems to answer business questions.

UNIT I MANAGEMENT INFORMATION SYSTEMS **9**

Types of MIS, Capabilities, Complements, CCR Framework; Role of manager with respect to IT in an organization, Database management systems, Data Warehousing, Foundations of business intelligence, Data and Text Mining.

UNIT II GLOBAL E-BUSINESS AND COLLABORATION **9**

Business processes and information systems, Types of information systems, Systems for collaboration and social business, Information systems function in business- Case study.

UNIT III INFORMATION SYSTEMS, ORGANIZATIONS AND STRATEGY **9**

Organizations and Information Systems, How Information Systems Impact Organizations and Business Firms, Using Information Systems to Achieve Competitive Advantage, Using Systems for Competitive Advantage: Management Issues- case study.

UNIT IV E-COMMERCE: DIGITAL MARKETS, DIGITAL GOODS **9**

E-commerce and the Internet- Business and Technology- Mobile Digital Platform and Mobile E-commerce- Building an E-commerce Presence- Case study.

UNIT V EMERGING TECHNOLOGIES **9**

Cloud computing, Big Data Technologies, Internet of Things, Bring Your Own Device (BYoD) Virtual Reality, Augmented Reality, Block chain, Artificial Inelligence.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Describe the use and function of management information systems
- Identify and describe the different roles of people in information systems
- Explain the strategic value of information systems in the organization
- Describe the impact of information systems in the larger context of ethics and globalization
- Identify trends in information systems that will impact the next generation of business

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TEXT BOOKS

1. Kenneth C. Laudon & Jane P. Laudon. "Management Information Systems". Pearson Publishing, 13th Edition.

ONLINE RESOURCE:

https://onlinecourses.nptel.ac.in/noc22_mg100/preview

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20BM713PE	ORGANIZATIONAL BEHAVIOUR	L T P C 3 0 0 3

The student should be made to:

- Understand the Perception in organization
- Understand the concepts of work attitude and the personality measurements
- Analyze the theory of emotion and motivation with different theories
- Explore the concept of management and its approach in team work
- Manage and plan the situation with the help of the available strategies to support the organization

UNIT I INTRODUCTION AND PERCEPTION AND LEARNING 9

Defining organization, behavior and organizational behaviour- assumptions of OB- principles of OB- levels of OB- scope of OB - OB and Human Resource Management - Applications of OB - Historical developments of OB - emerging concerns understanding perception- Basic elements of perception,- Principles of perceptual selection, - Perceptual grouping- Social Perception- Self-perception and identity- attribution of causality - Perceptual biases in social perception - Implications for human resource management - defining learning - classical and operant conditioning - learning in organizations

UNIT II PERSONALITY AND ATTITUDES 9

Defining Personality- History of the concept - Key assumptions - biological and social determinants, - Theories – Intrapsychic theory, social learning theory, self-theory, Trait and type theories - Related concepts (locus of control, dogmatism, authoritarianism, Machiavellianism) - measuring personality. Definition- Key elements of attitudes - Attitudes and related concepts (Values, opinion, belief and ideology) - Characteristics of attitudes - Attitude formation -Attitude measurement - Changing attitudes, - Attitudes at workplace (job satisfaction, work attitude and organizational commitment), - Prejudice and discrimination at workspace.

UNIT III EMOTIONS IN WORKPLACE AND MOTIVATION 9

Definition - Types of emotions - Related concepts (mood, temperament) - Stress in workplace- General Adaptation Syndrome - Managing Stress -Psychosomatic disorders and stress - emotional labor and emotional contagion. Definition- Process of motivation -Types of motives- Motivators at workplace - Motivation theories (Process and Content theories)

UNIT IV INTERPERSONAL DYNAMICS, POWER AND LEADERSHIP, TEAM DYNAMICS 9

Definition-Psychological Contract -Trust and trust building -Prosocial behaviour - Cooperation Vs Competition - Conflict management - Levels and types of conflict at workplace - Conflict management Styles - Managing Negotiations, Defining Power - Sources of Power - Organizational politics - Leadership - Managers Vs Leaders, - Trait and Type approach to leadership - Leadership style - Leadership Grid - Contingency Theories - Contemporary issues, Groups and Teams - Types of Teams - Stages in group development - problems in team work (Free riding, social loafing, group think) - Cross-cultural virtual teams.

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UNIT V ORGANIZATIONAL CULTURE, CHANGE, STRUCTURE AND DESIGN **9**

Defining culture -levels of culture -cultural dimensions - high and low context cultures - Strong and weak organizational cultures - Expressions of organizational culture - Impact of culture on individuals- Organizational cultural change - Change in Organizations - Nature of the chance process - Types of chance - Impact of change, - Managing resistance to change - Organizational Development interventions - Basic dimensions of structure Departmentalization - Organizational life cycle - Organizations as socio-technical systems - Organizational design and its impact on employees - Organizational boundary spanning.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Understand the various methods and terms used different organizational behaviour model.
- Describe the Individual Behaviour like attitude, perception, motivation, personality, misbehaviour and emotions.
- Apply managerial skills to make decisions and solve problems for achieving organizational objectives.
- Describe the group behaviour, leadership and power
- Understand the dynamics of organizational behaviour and managing change

TEXT BOOKS:

1. Udai Pareek, "Understanding Organizational Behaviour", Oxford University Press 3rd Edition.
2. Jerald Greenberg and Robert A. Baron, "Behaviour in Organizations", PHI learning private Ltd, New Delhi, 9th Edition.

REFERENCES

1. Nelson, Quick and Khandelwal, "Organizational Behaviour", Cengage Learning New Delhi, 2nd Edition.

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20BM604PE BIOMECHANICS

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Explain the principles of Mechanics.
- Discuss the mechanics of Physiological systems.
- Explain the mechanics of joints.
- Understand the mechanics of Bio solid
- Illustrate the mathematical models used in the analysis of biomechanical systems

UNIT I INTRODUCTION TO MECHANICS **9**

Introduction – Scalars and vectors, Statics – Force type, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium of coplanar forces, Dynamics, Basic principles – Linear motion, Newton's laws of motion, Introduction to Constitutive equations – Constitutive equations of Non viscous fluid, Newtonian Viscous fluid and Hookean Elastic solid

UNIT II BIOFLUID MECHANICS **9**

Intrinsic fluid properties Viscometers –Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure flow relationship for Non-Newtonian Fluids Fluid mechanics in straight tube – Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation.

UNIT III BIOSOLID MECHANICS **9**

Constitutive equation of viscoelasticity – Maxwell and Voight models, anisotropy, Hard Tissues – Structure, blood circulation, elasticity and strength, viscoeleastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modelling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hill's models, mathematical modelling, Bone fracture mechanics, Implants for bone fractures

UNIT IV BIOMECHANICS FOR JOINTS **9**

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video

UNIT V MODELLING AND EGRONOMICS **9**

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics – Musculo skeletal disorders, Ergonomic principles contributing to good workplace design, Design of computer work station, whole body vibrations, Hand transmitted vibrations.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the principles of mechanics
- Outline the principles of bio fluid dynamics
- Explain the fundamentals of bio-solid mechanics
- Apply the knowledge of joint mechanics
- Give Examples of computational mathematical modelling applied in biomechanics

TEXT BOOKS:

1. Fung Y C, "Bio-Mechanics – Mechanical Properties of Tissues", Springer-Verlag, 1998
2. Subrata Pal, "Textbook of Biomechanics", Viva Books Private Limited, 2009

REFERENCES:

1. Krishna B Chandran, AjitYoganathan, Stanley Erightser, "Biofluid Mechanics: The Human Circulation", Taylor and Francis, 2007
2. Sheraz S Malik and Shahbaz S Malik, "Orthopaedic Biomechanics Made Easy", Cambridge University Press, 2015
3. Jay D Humphrey and Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", Springer Science Business Media, 2004.
4. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press 2007.
5. Neil J Mansfeild, "Human Response to Vibration", CRC Press 2005.
6. Carl J Payton, "Biomechanical Evaluation of Movement in Sports and Exercise", 2008.

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20BM807PE	BIOMECHANICS OF JOINTS AND ORTHOPAEDIC IMPLANTS	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the Skeletal system of Human and its structure with its functions
- Learn the various measurement and calculation associated with Gait
- Understand how modeling of stress, strain of bone and its elasticity
- Know the various parameters necessary for designing implants along with its chances of failure
- Recognize the principles of bone and growth of implants through simulation

UNIT I MUSCULO SKELETAL SYSTEM **9**

Introduction to Musculo Skeletal system Bone, Muscle, Ligament, Tendon, Cartilage and Meniscus – Structure and Function, Anatomy of Synovial Joints. Biomechanics of Human joints (a) Hip Joint (b) Knee Joint (c) Shoulder Joint (d) Elbow joint

UNIT II GAIT ANALYSIS AND FORCES **9**

Biomechanics of Gait cycle. Gait Analysis Measurement techniques, 3D Motion analysis system – markers, cameras and force platform lower extremity – hip musculoskeletal forces, Joint Kinematics Principle of Forward and Inverse Dynamics Calculations on joint forces and moments

UNIT III MODELLING OF STRESS, STRAIN AND CORTICAL BONE **9**

Calculation on muscle forces, Model based estimation of musculoskeletal forces during movements. Concepts of Stresses and Strain Bone structure – Cancellous and Cortical Bone Mechanical Behaviour of Bone, Bone Adaptation and Viscoelasticity, Bone Anisotropy

UNIT IV DESIGN CONSIDERATIONS OF IMPLANTS **9**

Biomechanics of Joint Replacement – Hip, Knee, Shoulder, Spine Cemented and Cement less fixation, Failure mechanisms of implants, Implant Design Considerations, Biomedical modeling techniques and analysis

UNIT V SIMULATION OF BONE AND GROWTH OF IMPLANTS **9**

Finite Element Analysis of bone and implant Bone Remodelling – formulation, algorithm, simulation Experimental validations of numerical models, Bone fracture healing, Tissue differentiation, Mechanoregulatory principle, Mechanobiology based simulation of bone in growth around implants – acetabular and femoral components

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the Musculo skeletal system and its functions
- Explain how analysis is done on Gait and appreciate the various forces acting on the body
- Interpret the model of stress, strain and forces acting on the system as whole
- Elucidate the Joint, Spine and Implant design considerations
- Give a detailed inference on the simulations results done on the implants

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TEXT BOOKS:

1. Margareta Nordin, Victor H Frankel, "Basic Biomechanics of the Musculoskeletal System", Lippincott Williams and Wilkins, Third Edition.

REFEENCES:

1. David A Winter, "Biomechanics and Motor Control of Human Movement", First Edition, John Wiley and Sons Inc, 2009.
2. David L Bartel, Dwight T Davy, Tony M Keaveny, "Orthopaedic Biomechanics: Mechanics and Design in Musculoskeletal Systems", Pearson Prentice Hall Bioengineering,2007.

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20BM802PE **ERGONOMICS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Have exposure to principles of visual and auditory ergonomics
- Learn the mechanics of muscle physiology
- Study the different controls and motion capabilities
- Understand the nuances of Anthropometry from the fundamental principles
- Get familiarity with the mathematical models, analysis and design of biomedical devices using case studies

UNIT I VISUAL AND AUDITORY ERGONOMICS **9**

Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – Human factor aspects of hard copy text and computer screen text, Factors in selecting graphic representation symbols, qualitative visual display – process of hearing – principles of auditory display

UNIT II MUSCLE PHYSIOLOGY **9**

Muscle physiology – Muscle metabolism – Respiratory response – Joint motion study – Measure of physiological in-efficiency and energy consumption – work rest cycles – Aspects of manual and posture study, material handling (MMH) Bio mechanical recommended limits of MMH

UNIT III CONTROLS AND DISPLAYS **9**

Spatial compatibility, Physical arrangement of displays and controls – Movement capability – Rotary controls and rotary displays, Movement of displays, Orientation of the operator and movement relationships, control orders and control responses – Human limitations in tracking task

UNIT IV ANTHROPOMETRY **9**

Anthropometry – Anthropometric design principles – Work space envelope – Factors in design of work space surfaces – Principles of seat design – Principles of control panel. Organizational classification of human errors, Theories of accident, Causation – Reducing accidents by altering behavior

UNIT V CASE STUDIES **9**

Case Study 1: Computer Design, Control panel design of an electronic instrument, Computer key board, Hand drill… Case Study 2: Biomedical Application, Design optimization of Medical Equipments

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Appreciate Ergonomics on Visual and Auditory aspects
- Explain the functioning of the muscle in greater detail
- Design and interpret on various controls and displays
- Illustrate the measurements and proportions of the Human body
- Analyse the Ergonomics through various case studies

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TEXT BOOKS:

1. Pascale Carayon, "Handbook of Human Factors and Engineering", Second Edition, CRC Press, 2011
2. Robert N Bailey, "Human Performance Engineering", Third Edition, Prentice Hall, 1996.

REFERENCES:

1. Shrawan Kumar, "Biomechanics in Ergonomics", Second Edition, CRC Press, 2007.
2. Stephen Pheasant, Christine M Haslegrave, "Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, Third Edition, 2016.
3. Martin Helander, " Guide to Human Factors and Ergonomics, Second Edition, CRC Press, 2005

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20BM701PE PHYSIOLOGICAL MODELING

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Explain the application of Physiological models and vital organs
- Formulate the methods and techniques for analysis and synthesis of dynamic models
- Describe the dynamic models, simulate and visualize dynamic responses of physiological models using software
- Describe nonlinear models of physiological systems
- Compute the simulation of physiological systems

UNIT I INTRODUCTION TO PHYSIOLOGICAL MODELING **9**

Approaches to modeling: The technique of mathematical modeling, Classification of models, Characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to Physiology (Homeostasis, Cell Biology) Modeling physical systems, Linear models of physiological systems, The Laplace Transform, Transfer functions and Block diagram analysis physiology.

UNIT II MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM **9**

Dynamic systems and their control, Modeling and Block diagrams, The pupil control systems (Human Eye), General structure of control systems, The Dynamic response characteristics of the pupil control system, Open and Close loop systems instability, Automatic aperture control

UNIT III NONLINEAR MODELS OF PHYSIOLOGICAL SYTEMS **9**

Nonparametric Modeling – Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modeling – Basic Parametric Model Forms and Estimation Procedures – Volterra Kernels of Nonlinear Differential Equations, Discrete Time Volterra Kernels of NARMAX Models

UNIT IV COMPARTMENTAL PHYSIOLOGICAL MODEL **9**

Modeling the body as compartments, Behavior in simple compartmental system, Pharmacokinetic model and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, Model of systematic blood flow and Model of coronary circulation. Mathematical modeling of the system, Lumping and Partial Differential equations, Mathematical Model of the controlled process of the body

UNIT V SIMULATION OF PHYSIOLOGICAL SYSTEMS **9**

Simulation of physiological system using open CV / MATLAB software. Biological receptors: Introduction, Receptor characteristics, Transfer function models of receptors, Receptor and perceived intensity, neuromuscular model, renal system, Drug delivery model

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the application of Physiological models
- Describe the methods and techniques for analysis and synthesis of Linear and Dynamic system
- Develop differential equations to describe the compartmental physiological model

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- Describe Nonlinear models of physiological systems
- Illustrate the simulation of physiological systems

TEXT BOOKS:

1. Michel C Khoo, "Physiological Control Systems – Analysis, Simulation and Estimation", Prentice Hall of India, 2001.
2. Marmarelis, "Nonlinear Dynamic Modelling of Physiological Systems", Wiley – IEEE Press, 2004.

REFERENCES:

1. Benjamin C Kuo, "Automatic Control Systems", Tenth Edition, McGraw Hill Education, 2017.
2. David T Westwick, Robert E Kearney, "Identification of Nonlinear Physiological Systems, Wiley – IEEE Press, 2003.
3. Marmarelis V Z, "Advanced methods of Physiological Modelling", Springer, 1989
4. Stark L, "Neurological Control System", Plenum Press, 1968.
5. John H Milsum, "Biological Control Systems", McGraw Hill, 1966.
6. MinruiFei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su, "Advanced Computational Methods in Life System Modelling and Simulation", Springer, 2017.

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BoS/BME

20BM810PE	MODELING AND DESIGNING OF BONE AND DENTAL IMPLANTS	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Explain the basic of Finite Element Analysis
- Describe the types of elements and apply in different conditions
- Explain the modeling of bone
- Illustrate the modeling properties and design the various implants
- Apply the processing steps and operations involved in finite element modeling

UNIT I BASICS OF FINITE ELEMENT ANALYSIS **9**

Introduction, Basic equations in elasticity, Matrix displacement formulation, Element shapes, Nodes, Nodal unknowns and coordinate systems, Shape functions, One dimensional, Two dimensional, Three dimensional, Polynomial shape functions

UNIT II CLASSIFICATIONS OF FINITE ELEMENT ANALYSIS **9**

Strain displacement matrix, Bar element, Constant strain triangle element, Linear elements, Quadratic elements, Analysis of one dimensional problem, Rectangular elements, Linear triangular elements, Quadratic triangular elements

UNIT III MODELING OF BONE IMPLANTS **9**

Basic segmentation, Advanced segmentation of lower and upper extremity bone, 3D modeling of shoulder, 3D modeling of Spine, Segmentation and meshing of femur

UNIT IV MODELING AND DESIGNING OF DENTAL IMPLANTS **9**

Modeling and designing of dental implants, Modeling and designing of hip implants, Modeling and designing of knee implants

UNIT V FINITE ELEMENT MODELING **9**

Introduction, Modeling operations, Boolean operations, Additional operations, Preprocessing and Post processing steps in Finite Element Analysis, Finite Element modeling of femur bone and Spine

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the fundamentals of Finite element analysis
- Describe the classification of Finite element analysis
- Express his ability to model bone implants
- Articulate the dental implants design and model
- Elucidate the finite element modelling and processing steps

TEXTBOOK:

1. Bhavikati S S, "Finite Element Analysis", New Age International Limited, First Edition, 2005

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REFERENCES:

1. Saeedmoaveni, "Finite Element Analysis, Theory and Application with ANSYS", Prentice Hall, Third Edition, 2007
2. ErdoganMadenci, Ibrahim Guven, "The Finite Element Method and applications in engineering using Ansys", Springer, First Edition, 2006

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20BM603PE BIOFLUIDS AND DYNAMICS

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the basics of Fluid Mechanics and its relevance to life
- Analyze cellular and ocular fluid dynamics
- Examine the cardiovascular and respiratory fluid mechanics
- Observe Blood Rheology dynamics of human
- Learn mathematical modeling of fluid biological systems

UNIT I BIOFLUID MECHANICS 9

Intrinsic fluid properties – Displacement and velocity, Sheer stress ad viscosity Bernoulli equation, Introduction to pipe flow – Reynolds number, Poiseuille's law, Flow rate, Womersley number, Constitutive equations – Newtonian fluid, Non-Newtonian viscous fluid.

UNIT II CELLULAR AND OCCULAR MECHANICS 9

Cellular Biomechanics – Eukaryotic cell structure, Cytoskeleton, Cell-matrix interactions, Mechanical property measurement – Atomic Force microscopy, Optical Trapping, Micropipette aspiration, Tissue cell mechanobiology –Ocular Biomechanics – Ocular anatomy, Biomechanics of Glaucoma, Ocular blood flow.

UNIT III BLOOD RHEOLOGY AND BLOOD VESSEL MECHANICS 9

Elements of Blood, Blood characteristics – Viscosity of blood, Einstein's equation, Biomechanics of red cell membrane, Apparent and relative viscosity, Blood viscosity variation, Casson's equation, Rheology of Blood in Micro vessels Anatomy and Physiology of blood vessels.

UNIT IV CARDIO RESPIRATORY MECHANICS AND SPACE MEDICINE 9

Cardiac cycle – Pressure volume diagram's Changes in contractility, Ventricular performance, Congestive heart failure, Pulsality index, Physics of valvular diseases, Respiratory system – Alveolar ventilation – lung volumes and capacities, Mechanics of breathing, Work of breathing – Lung compliance Gas exchange and transport, Oxygen dissociation curve.

UNIT V COMPUTATIONAL FLUID DYNAMICS 9

Computational fluid dynamics – CFD Code, Problem solving with CFD, Conservation Laws of Fluid, Motion and Boundary Conditions, Turbulence and its modelling, The Finite Volume Method for Diffusion Problems and Convection – Diffusion Problems, Solution Algorithms for Pressure – Velocity coupling in steady flows, Solution of Discretized Equations

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the basics of Fluid Mechanics
- Construe the intracellular fluid mechanics and ocular mechanics
- Describe the rheology of blood and mechanics of blood vessels
- Elucidate on cardiorespiratory mechanics and space medicine
- Develop mathematical models of biological systems with fluids

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TEXTBOOKS:

1. Krsihnan B Chandran, Ajit P Yoganathan, Stanley E Rittgers, "Biofluid Mechanics – The Human circulation", CRC Taylor and Francis, 2007.
2. Fung Y C, "Biomechanics – Mechanical properties of living tissues", Second Edition, Springer – Verilag, 1993.

REFERENCES:

1. Jung Heeseo, Vijay Vedula, Theodore Abraham and Rajat Mittal, "Multiphysics computational models for cardiac flow and virtual cardiography", Int. J Numer. Meth. Biomed. Engg, PP 850-869, 2013, DOI: 10.1002/cnm.2556
2. Lee Waite, Jerry Fine, " AppliedBiofluid Mechanics", McGraw Hill, 2007.
3. John K J Li, "Dynamics of Vascular System", World Scientific, 2004.
4. Ross Ethier C, Craig A Simmons, "Introduction to Biomechanics – From Cells to Organisms", Cambridge Texts in Biomedical Engineering, 2007.
5. Versteeg H K, Malalasekera W, "An Introduction to Computational Fluid Dynamics The Finite Volume Method", Longman Scientific and Technical, 1995.
6. Jeffery R Davis et al, "Fundamentals of Aerospace Medicine", Wolter Kluwer Health, Lippincott Williams and Wilkins, 2008

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20BM719PE **ASSISTIVE TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Know the hardware requirement various assistive devices
- Understand the hemodialyzer unit in assistive devices
- Know the anatomy of ear and principles of hearing aids
- Understand the prosthetic and orthotic devices
- Know the developments in assistive technology

UNIT I CARDIAC ASSIST DEVICES **9**

Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

UNIT II HEMODIALYSERS **9**

Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT III HEARING AIDS **9**

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

UNIT IV PROSTHETIC AND ORTHODIC DEVICES **9**

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

UNIT V RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Interpret the various mechanical techniques that will help in assisting the heart functions.
- Describe the underlying principles of hemodialyzer machine.
- Indicate the methodologies to assess the hearing loss.
- Evaluate the types of assistive devices for mobilization.
- Explain about TENS and biofeedback system.

TEXT BOOKS:

1. Joseph D. Bronzino, "The Biomedical Engineering Handbook", 3rd Edition, Three Volume Set, CRC Press, 2006.
2. Marion. A. Hersh, Michael A. Johnson, "Assistive Technology for visually impaired and blind", Springer Science & Business Media, 1st edition, 2010.
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, "Clinical Engineering", CRC Press, 1st edition, 2010.

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REFEENCES:

1. Kenneth J. Turner, "Advances in Home Care Technologies: Results of the match Project", Springer, 1st Edition, 2011.
2. Gerr M. Craddock, "Assistive Technology-Shaping the future", IOS Press, 1st Edition, 2003.
3. Matthew Dipaola, "3D Printing in Orthopaedic Surgery", Elsevier, 2019.
4. Daniel Goldstein, Mehmet Oz, "Cardiac Assist Devices", Wiley-Blackwell 2000.

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20BM606PE COMPUTATIONAL CONTINUUM MECHANICS **L T P C**
3 0 0 3

OBJECTIVES

The student should be made to:

- Realize the fundamental of continuum mechanics
- Understand the concept of kinematics
- Understand the functional analysis of kinetics
- Understand the Hyperelasticity
- Understand the various applications of linearization and discretization

UNIT I INTRODUCTION TO COMPUTATIONAL CONTINUUM MECHANICS **9**

Introduction – origins of nonlinearity
Mathematical Preliminaries -1: Tensors and tensor algebra
Mathematical Preliminaries -2: Linearization and directional derivative, Tensor analysis

UNIT II KINEMATICS **9**

Kinematics – 1: Deformation gradient, Polar decomposition, Area and volume change
Kinematics – 2: Linearized kinematics, Material time derivative,Rate of deformation and spin tensor

UNIT III KINETICS **9**

Kinetics – 1: Cauchy stress tensor, Equilibrium equations,Principle of virtual work
Kinetics – 2: Work conjugacy, Different stress tensors, Stress rates

UNIT IV HYPERELASTICITY **9**

Hyperelasticity - 1: Lagrangian and Eulerian elasticity tensor
Hyperelasticity - 2: Isotropic hyperelasticity, Compressible Neo-Hookean material

UNIT V LINEARIZATION AND DISCRETIZATION **9**

Linearization: Linearization of internal virtual work, Linearization of external virtual work
Discretization: Discretization of Linearized equilibrium equations – material and geometric tangent matrices
Solution Procedure: Newton-Raphson procedure, Line search and Arc length method

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the fundamental of continuum mechanics
- Realize the concept of kinematics
- Identify the functional analysis of kinetics
- Realize the Hyperelasticity
- Analyze the various applications of linearization and discretization

TEXT BOOKS:

1. J. Bonet A. J. Gil and R. D. Wood, "Nonlinear Solid Mechanics for Finite Element Analysis : Statics" Cambridge University Press, 2016.

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REFERENCES:

1. J. Bonet A. J. Gil and R. D. Wood, "Nonlinear Solid Mechanics for Finite Element Analysis : Statics" Cambridge University Press, 2016.
2. K.-J. Bathe, "Finite Element Procedures", Prentice-Hall India, New Delhi, 1996.
3. A. F. Bower, "Applied Mechanics of Solids", CRC Press, Boca Raton, 2010.

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20BM709PE BIOMETRIC SYSTEMS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Realize the fundamental ideas of Biometric systems
- Understand the technologies of fingerprint, iris, face and speech recognition
- Understand the general principles of design of biometric systems and the underlying trade-offs
- Recognize personal privacy and security implications of biometrics based identification technology
- Identify issues in the realistic evaluation of biometrics based systems

UNIT I INTRODUCTION TO BIOMETRICS **9**

Introduction and background – Biometric technologies – Passive Biometrics – Active Biometrics – Biometrics Versus traditional techniques – Benefits of Biometrics – Operation of a Biometric system – Key Biometric processes: Verification, Identification and Biometric Matching – Performance measures in Biometric systems: FAR, FRR, FTE rate, FTA rate and Need for strong authentication – Protecting privacy and biometrics and policy – Biometric Applications.

UNIT II FINGERPRINT IDENTIFICATION TECHNOLOGY **9**

Fingerprint Patterns, Fingerprint Features, Fingerprint Image, and Widthbetween two ridges – Fingerprint Image processing – Minutiae Determination – Fingerprint Matching: Fingerprint Classification, Matching policies

UNIT III FACE AND IRIS RECOGNITION **9**

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel based Methods and 3D Models, Methods for assessing progress in Face Recognition, Eyes-Iris Recognition, Eyes-Retina Recognition-Representation and Classification-Future of Iris recognition.

UNIT IV VOICE SCAN **9**

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration

UNIT V FUSION IN BIOMETRICS **9**

Introduction to Multi-biometric –Information Fusion in Biometrics – Issues in Designing a Multi-biometric System – Sources of Multiple Evidence – Levels of Fusion in Biometrics – Sensor level, Feature level, Rank level, Decision level fusion – Score level Fusion. Examples – Bio-potential and Gait based Biometric systems

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Demonstrate the underlying biometric systems engineering principles
- Appreciate the Fingerprint uniqueness in the identification of Human
- Appraise the nuances of Face Recognition in the Biometric systems
- Evaluate the Features and components of different voices and strenths
- Exhibit the fusion techniques while analyzing the Biometric systems

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TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, "Biometric Systems, Technology Design and Performance Evaluation", Springer, 2005
2. David D Zhang, "Automated Biometris: Technologies and Systems", Kluwer Academic Publishers, New Delhi, 2000.

REFERENCES:

1. Paul Reid, "Biometrics for Network Security", Pearson Education, 2004.
2. Nalini K Ratha, Ruud Bolle, "Automatic Fingerprint Recognition System", Springer, 2003.
3. Jain L C, Hayashi I, Lee S B, Halici U, "Intelligent Biometric Techiques in Fingerprint and Face Recognition", CRC Press, 1999
4. John Chirillo, Scott Blaul, "Implementing Biometric Security", John Wiley, 2003
5. Kung S Y, Lin S H, Mak M W, "Biometric Authentication: A Machine Learning Approach", Prentice Hall, 2005.
6. Arun A Ross, Karthik Nandakumar, Jain A K, "Handbook of Multibiometrics", Springer, New Delhi, 2000.

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BoS/BME

20BM601PE BIOSIGNAL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG and EMG
- Understand choice of filters to remove noise and artifacts from biomedical signals
- Apply established engineering methods to analyse ECG signal problems
- Apply established engineering methods to analyse neurological signals
- Analyze various biomedical signals through advanced techniques

UNIT I INTRODUCTION TO BIOMEDICAL SIGNALS **9**

Bio signal Characteristics of Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrogastrogram (EGG), Electroneurogram (ENG),Event related potentials (ERP) Phonocardiogram (PCG), Speech signal, Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer aided diagnosis.

UNIT II FILTERING FOR REMOVAL OF ARTIFACTS **9**

Time domain Filters – synchronized averaging, Moving average Filters, Derivative based operators to remove low frequency artifacts. Frequency-domain filters – Removal of High and Low frequency noise. Removal of periodic artifacts, optimal filter – Wiener filter, Adaptive filters for removal of interference

UNIT III CARDIOVASCULAR APPLICATIONS **9**

Noise and Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise cancelling in ECG, improved adaptive filtering in FECG, Wavelet detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis (PCA and ICA) - Segmentation of PCG, intensity patterns, Spectral modelling and analysis of PCG signals.

UNIT IV NEUROLOGICAL APPLICATIONS **9**

EEG rhythms and waveforms, EEG applications – Epilepsy, sleep disorders, Brain Computer Interface. Modeling EEG – linear, stochastic models – Non linear modelling of EEG – artifacts in EEG and their characteristics and processing- Non parametric spectral analysis, Model based spectral analysis – EEG segmentation – Joint Time – Frequency analysis – correlation analysis of EEG channels – coherence analysis of EEG channels- Evoked potentials – noise characteristics, Noise reduction by linear filtering

UNIT V ANALYSIS OF WAVESHAPE, SIGNAL CLASSIFICATION AND RECOGNITION **9**

Modelling intramuscular EMG – intramuscular signal decomposition – Fractal analysis of EMG signals. Statistical signal analysis of VAG signals. Analysis of amplitude and latency of MEG signals. Analysis of ERP effect. Signal classification and recognition –Back propagation neural network based classification- Evoked potentials – noise characteristics, Noise reduction by linear filtering Analysis of EEG using Empirical mode decomposition (EMD)

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Draw different types of biomedical signals and identify their spectral components
- Use different types of biomedical signals and identify their spectral components
- Identify physiological interferences and artifacts affecting ECG signal
- Compute power and correlation spectra of EEG signals
- Propose an algorithm to classify biomedical signals

TEXTBOOKS:

1. Rangayyan, "Biomedical Signal Analysis", Wiley, 2002.
2. Semmlow, "Bio signal and Biomedical Image Processing", Marcel Dekker, 2004.

REFERENCES:

1. Arnon Cohen, "Biomedical Signal Processing Vol 1 and Vol II", CRC Press Inc., Boca Rato, Florida 1999.
2. Reddy D C, " Biomedical Signal Processing: Principles and Techniques", Tata McGraw Hill, New Dlehi, 2005.
3. Wills J Tompkins, "Biomedical Digital Signal Processing", Prentice Hall, 1993
4. Bruce, " Biomedical Signal Processing and Signal Modeling", Wiley, 2001.
5. Sornmo, "Bioelectric Signal Processing in Cardiac and Neurological Applications", Elsevier, 2005.

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20BM811PE PATTERN RECOGNITION AND EXPERT SYSTEMS IN MEDICINE **L T P C 3 0 0 3**

OBJECTIVES:

The student should be made to:

- Have an insight about the different types of pattern classification techniques
- Explain the concepts of structures, strategies and searching techniques in artificial intelligence
- Describe and use the concepts of knowledge representation and reasoning in AI application
- Describe about types and methods of learning
- Analyze about the application of AI in medical field and use feature extraction based on clustering

UNIT I CLASSIFICATION OF PATTERNS **9**

Classes, Patterns and features, Pattern similarity and PR tasks, Pattern discrimination, Feature space metrics and covariance matrix, Feature selection and extraction methods, Statistical, Syntactic and descriptive approaches, Bayesian classification, Bayes rule for minimum risk, Minimum error rate classification, Discriminant functions and decision surfaces, Linear discriminant functions

UNIT II INTELLIGENCE AND SEARCHING **9**

Artificial Intelligence components, Problem definition, Problem solving agents, State Space search, Uniformed search – Depth first and breadth first search, DFS with iterative deepening, Informed / heuristic search, A Algorithm, AND – OR graphs, Searching with partial information-online search agents and unknown environments, Constraint satisfaction problems

UNIT III KNOWLEDGE AND REASONING **9**

Logical Agents, Propositional Calculus, Syntax and Semantics of First order logic, Forward and Backward chaining, Resolution-Theorem proving problems using resolution, AI Representational schemes – semantic nets, conceptual graphs using frames and scripts, Production system, Rule based expert system

UNIT IV LEARNING TYPES AND METHODS **9**

Classes, Forms of learning, inductive learning, Decision trees, Learning using relevance information, Statistical learning methods – EM algorithm, Intelligence using neural networks, Reinforcement learning – Passive and Active reinforcement

UNIT V APPLICATIONS IN MEDICINE **9**

Unsupervised clustering, K means clustering, Fuzzy C means clustering, AI in diagnosis – ELISA model, Biometrics in e-health security, Face recognition, Gene matching, Automated drug delivery systems, Mining of Electronic Health record, Tumor boundary detection

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Classify different types of pattern recognition, feature extraction
- Identify and apply AI components to search techniques and problem solving
- Describe the knowledge of Agents, schemes and rule base followed for reasoning

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- Explain the types decision trees and learning methods
- Interpret and apply the learned concepts in the medical field for diagnosis and metrics

TEXT BOOKS:

1. Stuart Jonathan Russel, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, Third Edition, 2013
2. George F Luger, "Artificial Intelligence – Structures and Strategies for Complex Problem Solving", Pearson Education, Fourth Edition, 2002

REFERENCES:

1. Rochard O Duda and Hart P E and David G Stork, "Pattern classification", John Wiley and Sons Inc, Second Edition, 2001
2. Carlo Combi, Yuval Shahar, "Artificial Intelligence in Medicine – 12th Conference, Springer, 2001
3. Svetlana N Yanushkevich, Image Pattern Recognition Synthesis and Analysis in Biometrics" Vol 67, World Scientific, 2007.
4. Anke Meyer Base, "Pattern Recognition for Medical Imaging", Elsevier, First Edition, 2004.

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20BM809PE COMPUTATIONAL METHODS FOR SIGNAL AND IMAGE PROCESSING

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the fundamentals of Time – Frequency Domain Analysis and the concepts of wavelets
- Acquire knowledge on the concepts of PCA and ICA
- Illustrate the concept of morphological operations and algorithms used in medical images
- Explain the image registration and image visualization algorithms
- Describe the advanced signal and image processing techniques in medical imaging applications

UNIT I INTRODUCTION TO TIME-FREQUENCY DOMAIN ANALYSIS 9

Introduction to wavelets, Time Frequency representation, Short time Fourier transform: Spectrogram, Wigner-ville distribution, Discrete wavelet transform, Pyramid algorithm, Comparison of Fourier transform and wavelet transform, Dual tree complex wavelet transform, Filter banks, Wavelet packets

UNIT II PCA AND ICA 9

Principle Component Analysis (PCA) – Introduction, Order Selection, Data rotation, PCA evaluation, Independent Component Analysis (ICA)

UNIT III MORPHOLOGICAL OPERATIONS 9

Erosion and dilations, Opening and Closing, Hit of Miss transformations, Some basic morphological algorithms – Boundary extraction, Hole filling, Thinning, Thickening, Skeletons, Pruning, Morphological reconstructions, Gray scale morphology

UNIT IV IMAGE REGISTRATION AND VISUALIZATION ALGORITHMS 9

Registration – rigid registration and non rigid registration algorithms, Registration of MRI and PET images, registration of MRI and CT images for clinical applications, Image visualization – 2D visualization, 3D visualization – surface and volume based display methods

UNIT V ADVANCES IN MEDICAL IMAGING APPLICATIONS 9

Medical imaging in diagnosis of osteoporosis and estimation of individual bone fracture risk, Diagnosis of diabetic retinopathy, Diagnosis and treatment of spinal deformity, Detecting and Analyzing linear structures in biomedical images: A case study of corneal nerve fibres, A case study approach in mammography image analysis, Image fusion pixel based methods

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Do analysis of image and signals in the time and frequency domains
- Evaluate the principle and independent component analysis
- Perform morphological operations on boundary extractions and reconstructions
- Examine image registration algorithms and visualizing dimensions
- Appraise the trending medical image applications

TEXT BOOKS:

1. John L Semmlow, Benjamin Griffel, "Biosignal and Medical Image Processing", CRC Press, Third Edition, 2014
2. Dougherty, "Medical Image Processing Techniques and Applicaions", Springer-Verilog, First Edition, 2001

REFERENCE BOOKS:

1. Hanjal J, Hawkes D and Hill D, "Medical Image Registration", CRC Press, First Edition, 2001
2. Haidekker M A, "Advanced Medical Image Analysis", Wiley, First Edition, 2010
3. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education Asia, Third Edition, 2007
4. Thomas M Deserna, "Biomedical Image Processing", Springer Berlin Heidelberg, First Edition, 2011

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20CS808PE	COMPUTER VISION	L T P C
	(Common to BME and CSE)	2 0 2 3

OBJECTIVES:

The Student should be made to:

- Understand the fundamental concepts related to Image formation and processing.
- Learn feature detection, matching and detection
- Become familiar with feature based alignment and motion estimation
- Develop skills on 3D reconstruction
- Understand image based rendering and recognition

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 6

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms- Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 6

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge – Mean shiftand mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 6

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration – Triangulation- Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure andmotion - Translational alignment - Parametric motion - Spline-based motion - Optical flow – Layeredmotion.

UNIT IV 3D RECONSTRUCTION 6

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 6

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

30 PERIODS

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PRACTICAL EXERCISES: **30 PERIODS**

LABORATORY EXPERIMENTS:

Software needed:

- OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent

1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images
4. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection
5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORBImage features, Feature matching, cloning, Feature matchingbased image alignment
6. Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid
8. Pose Estimation
9. 3D Reconstruction – Creating Depth map from stereo images
10. Object Detection and Tracking using Kalman Filter, Camshift

- docs.opencv.org
- https://opencv.org/opencv-free-course/

TOTAL : 60 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand basic knowledge, theories and methods in image processing and computer vision.
- Implement basic and some advanced image processing techniques in OpenCV.
- Apply 2D a feature-based based image alignment, segmentation and motion estimations.
- Apply 3D image reconstruction techniques
- Design and develop innovative image processing and computer vision applications.

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TEXT BOOK:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts inComputer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, SecondEdition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

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BoS (CSE)

20BM803PE	BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the basic concepts of Brain Computer Interface
- Study the various signal acquisition methods
- Learn about the signal processing methods used in BCI
- Understand various Machine Learning Methods of BCI
- Learn the various applications of BCI

UNIT I INTRODUCTION TO BCI **9**

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 II BRAIN ACTIVATION **9**

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 III FEATURE EXTRACTION METHODS **9**

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 IV MACHINE LEARNING METHODS FOR BCI **9**

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 V APPLICATIONS OF BCI **9**

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. Non invasive BCIs: P300 Mind speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Comprehend and appreciate the significance and role of this course in the contemporary world
- Evaluate concept of BCI
- Assign functions appropriately to the human and to the machine
- Select appropriate feature extraction methods
- Use machine learning algorithms for translation

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TEXT BOOKS:

1. Rajesh P N Rao, "Brain Computer Interfacing: An Introductio", Cambridge University Press, First Edition, 2013
2. Jonathan Wolpaw, Elizabeth winter wolpaw, "Brain Computer Interfaces: Principles and Practice", Oxford University Press, USA, First Edition, 2012.

REFERENCES:

1. Ella Hassianien A and Azar A T, "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015
2. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain Computer Interfaces : Revolutionizing Human Computer Interaction", Springer,2010
3. Ali Bashashati, Mehrdad Fatourechi, 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, Vol.4,2007, PP.32-57
4. Arnon Kohen, "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

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BoS/BME

20BM813PE **SPEECH PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- To understand the fundamentals of the speech processing
- Explore the various speech models
- Gather knowledge about the phonetics and pronunciation processing
- Perform wavelet analysis of speech
- To understand the concepts of speech recognition

UNIT I INTRODUCTION **9**

Introduction - knowledge in speech and language processing - ambiguity - models and algorithms - language - thought - understanding - regular expression and automata - words & transducers – N grams

UNIT II SPEECH MODELLING **9**

Word classes and part of speech tagging – hidden markov model – computing likelihood: the forward algorithm – training hidden markov model – maximum entropy model – transformation- based tagging – evaluation and error analysis – issues in part of speech tagging – noisy channel model for spelling

UNIT III SPEECH PRONUNCIATION AND SIGNAL PROCESSING **9**

Phonetics - speech sounds and phonetic transcription - articulatory phonetics - phonological categories and pronunciation variation - acoustic phonetics and signals - phonetic resources - articulatory and gestural phonology

UNIT IV SPEECH IDENTIFICATION **9**

Speech synthesis - text normalization - phonetic analysis - prosodic analysis – diphone waveform synthesis - unit selection waveform synthesis – evaluation

UNIT V SPEECH RECOGNITION **9**

Automatic speech recognition - architecture - applying hidden markov model - feature extraction: mfcc vectors - computing acoustic likelihoods - search and decoding - embedded training - multipass decoding: n-best lists and lattices- a* (_stack') decoding - context-dependent acoustic models: triphones - discriminative training - speech recognition by humans

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Create new algorithms with speech processing
- Derive new speech models
- Perform various language phonetic analysis
- Create a new speech identification system
- Generate a new speech recognition system

TEXTBOOK:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Person education, 2013.

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20BM607PE **COMPUTATIONAL NEUROSCIENCE** **L T P C**
3 0 0 3

OBJECTIVES

The student should be made to:

- Think computationally about neuroscience problems at several levels of analysis.
- Apply knowledge of the fundamentals of computer programming by manipulating, analyzing, and visualizing real-world datasets.
- Conceptually articulate the underlying mathematics of these models..
- Describe several critical levels of analysis where one can model neural function.
- Compare and contrast among the different levels and evaluate the utility of each level for explaining how we perceive, think, and remember.

UNIT I INTRODUCTION TO NEURONS **9**

Neuron structure, Networks of Neurons and Synapses, System of neural processing, Basic structures in the brain, Sensory - Executive - Behavior systems; Excitable Membranes and Neural Activity; Membrane Potential and All or None Spike, Patch Clamp Techniques, Membrane Potential, Ion Channels, Current Injection – Synapses, Single neuron activity

UNIT II: POINT MODELS AND ANALYSIS OF NEURAL MODELS **9**

Point and Compartmental Models of Neurons, Hodgkin Huxley Equations – I, Hodgkin Huxley Equations – II, Reducing the HHE and Moris-Lecar Equations (MLE), Properties of MLE, Phase Plane Analysis – I, Phase Plane Analysis – II, Analyzing HHE, Bifurcations, Other Point Models

UNIT III ENCODING AND DECODING **9**

Random Variables and Random Processes, Spike Train Statistics and Response Measure,Receptive fields and Models of Receptive Fields, The Spike Triggered Average (Coding)-Stimulus Reconstruction (Decoding), Spike Trains: Encoding and Decoding – II- Nonlinear approaches: Basics of Information Theory, Maximally Informative Dimensions, Discrimination based approaches, Measuring Spike Train Distances, Statistical Methods in Discrimination, Spike Trains: Encoding and Decoding – III- Neural Population Based Encoding/Decoding - I

UNIT IV PLASTICITY **9**

Plasticity – I- Synaptic Transmission and Synaptic Strength, Ways of Modification of Synaptic Strength, Types of Plasticity, Short Term Plasticity – I, Short Term Plasticity – II, Plasticity – II- Implications of Short Term Plasticity, Long Term Plasticity – I, Long Term Plasticity – II- Modeling Long Term Plasticity, Computational Implications

UNIT V MODELING PHENOMENA WITH PLASTICITY **9**

Adaptation, Attention, Learning and Memory – I, Learning and Memory – II, Developmental Changes, Conditioning and Reinforcement Learning, Reward Prediction (Error), Decision Problems, Learning and Memory – II, Developmental Changes, Optimal Coding Principles – I, Optimal Coding Principles – II, Theoretical Approaches to Understanding Plasticity, Current Topics – I, Current Topics – II

TOTAL: 45 PERIODS

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OUTCOMES

On successful completion of this course, the students will be able to,

- Compute neuroscience problems at several levels of analysis
- Acquire knowledge of the fundamentals of computer programming by manipulating, analyzing, and visualizing real-world datasets
- Conceptually articulate the underlying mathematics of these models
- Describe several critical levels of analysis where one can model neural function
- Compare and contrast the different levels and evaluate the utility of each level for explaining how we perceive, think, and remember

TEXTBOOK:

1. Dayan and Abbott, "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems".
2. Oppenheim and Wilsky, "Signal and Systems".
3. Cover and Thomas, "Information Theory and Coding".

REFERENCES:

1. Strogatz, "Nonlinear Dynamics and Chaos".
2. Koch and Segev, "Methods in Neuronal Modeling".
3. Hille, "Ion Channels of Excitable Membranes".
4. Kandel and Schwartz, "Principles of Neural Science".

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20BM706PE VIRTUAL REALITY AND AUGMENTED REALITY **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Nurturethe existing technology on Virtual Reality
- Acquire the stages of development process
- Study about the content creation consideration of Virtual Reality
- Understand Virtual Reality, Augmented Reality and using them to build Biomedical Engineering applications
- Know the intricacies of these platform to develop PDA applications with better optimality

UNIT I INTRODUCTION **9**

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: Graphic displays – sound displays and haptic feedback

UNIT II VR DEVELOPMENT PROCESS **9**

Geometric modeling – Kinematics modeling – Physical modeling – Behavior modeling – Model management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR **9**

Methodology and terminology – User performance studies – VR health and safety issues – Usability of virtual reality system – Cyber sickness – Side effects of exposures to virtual reality environment

UNIT IV VR ON THE WEB AND VR ON THE MOBILE **9**

JS-Pros and Cons – Building blocks, WebVR, WebGL, Three.js, Device Orientation Events – Frameworks, A-Frame, React VR – Google VR for Android – Scripts, Mobile Device configuration, Building to Android cameras and Interaction – Teleporting- Spatial Audio – Accessing Human Parameters – Device development and drivers – Design Haptics

UNIT V APPLICATIONS **9**

Medical Applications – Military Applications – Robotic Applications – Advanced Real Time Tracking – Other Applications – Games, Movies, Simulations, Therapy

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Design the system for the given specification with reasonable engineering fundamentals
- Analyze the process to meet the given realistic engineering constraints
- Identify problem statements and function as a member of an engineering design team
- Propose technical documents and give technical oral presentations related to design results
- Utilize the technical resources to the need and welfare of the society

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TEXT BOOKS:

1. Burdea C and Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley and Sons, 2008
2. Jason Jerald, The Virtual Reality Book: Human Centred Design for Virtual Reality", Association for Computing Machinery and Morgan and Claypool, New York, NY, USA, 2015.

REFERENCES:

1. Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice", Pearson Education (US), Addison Wesley Educational Publishers Inc, New Jersey, United States, 2016.
2. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications and Human Factors for AR and VR", Addison Wesley Professioal, First Edition, 2016.
3. Robert Scoble and Shel Israel, Patrick Brewster, " The Fourth Transformation: How Augmented Reality and Artificial Intelligence will change everything", Patrick Brewster Press, First Edition, 2016.
4. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web and Mobile", O'Reilly Media, First Edition, 2015.
5. Tony Parisi, "Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages", O'Reily Media, First Edition, 2014.
6. Jos Dirksen, "Learning Three.js: The Javascript 3D Library for WebGL", Second Edition, 2015.

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20BM808PE WEARABLE SYSTEMS **L T P C**
(Common to BME and ECE) **3 0 0 3**

OBJECTIVES:

The student should be made to:

- Identify the existing technology through demonstrations with a futuristic vision along with socio economic impact and issues
- Process the signals required for wearable electronics
- Know the sensor and signal processing requirement of wearable systems
- Understand the communication and security aspects
- Know the level of energy involvement in wearable systems

UNIT I SENSORS **9**

Need for wearable systems, Sensors for wearable systems-inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, Pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS based Biosensors, E-Textiles, Biocompatibility

UNIT II SIGNAL PROCESSING **9**

Wearability issues – Physical shape and placement of sensor, Technical challenges – Sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, Light weight signal processing, Rejection of irrelevant information, Data mining

UNIT III ENERGY HARVESTING FOR WEARABLE DEVICES **9**

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

UNIT IV WIRELESS HEALTH SYSTEMS **9**

Need for wireless monitoring, Definition of Body Area Networks, BAN and Healthcare, Technical Challenges – System security and reliability, BAN Architecture – Introduction, Wireless communication techniques

UNIT V APPLICATIONS OF WEARBLE SYSTEMS **9**

Medical Diagnostics, Medical Monitoring – Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait Analysis, Sports Medicine, Smart Fabrics

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

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

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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 Limited, Singapore, 2012
3. GuangZhong Yang, "Body Sensor Networks", Springer, 2006
4. Andreas Lymberis, Danilo de Rossi, "Wearable eHealth systems for Personalised Health Management – State of the art and future challenges", IOS Press, The Netherlands, 2004

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20BM814 PE **MEDICAL INFORMATICS** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the concept of Medical Informatics.
- Study the applications of information technology in health care management.
- Know the computers in clinical Laboratory
- This course provides knowledge on resources, devices, and methods required to optimizethe acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I INTRODUCTION TO MEDICAL INFORMATICS **9**

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 II COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING **9**

Automated clinical laboratories – Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III COMPUTERISED PATIENT RECORD **9**

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 IV COMPUTER ASSISTED MEDICAL DECISION-MAKING **9**

Neuro computers and Artificial Neural Networks application, Expert system - General model of CMD, Computer – assisted decision support system - production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS **9**

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health-Medical education and health care information, computer assisted instruction in medicine.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the structure and functional capabilities of Hospital Information System.
- Describe the need of computers in medical imaging and automated clinical laboratory.

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- Articulate the functioning of information storage and retrieval in computerized patient record system.
- Apply the suitable decision support system for automated clinical diagnosis.
- Discuss the application of virtual reality and telehealth technology in medical industry.

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:

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

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20BM705PE TELEHEALTH TECHNOLOGY **L T P C**
(Common to BME and ECE) **3 0 0 3**

OBJECTIVES:

The student should be made to:

- Learn the key principles for telemedicine and health
- Gain knowledge about information and communication infrastructure for telemedicine
- Have the required knowledge on ethical and legal aspects of telemedicine
- Understand telemedical technology
- Know telemedical standards, mobile telemedicine and its applications.

UNIT I FUNDAMENTALS OF TELEMEDICINE **9**

History of telemedicine, Definition of telemedicine, Tele-Health, Tele-care, scope, Telemedicine systems, Benefits and Limitations of telemedicine.

UNIT II TYPE OF INFORMATION AND COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE **9**

Audio, Video, Still images, Text and Data, FAX type of communications and network: PSTN, POTS, ANT, ISDN, Internet, Air/Wireless Communications, GSM satellite, Microwave, Mobile health and ubiquitous healthcare.

UNIT III ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE **9**

Confidentiality, Patient rights and consent: Confidentiality and the law, the Patient-Doctor relationship, Access to Medical records, Consent treatment – Data protection and Security, Jurisdictional issues, Intellectual Property Rights.

UNIT IV PICTURE ARCHIVING AND COMMUNICATION SYSTEM **9**

Introduction to Radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, Technical Issues, PACS architecture

UNIT V APPLICATION OF TELEMEDICINE **9**

Teleradiology, Telepathology, Telecardiology, Teleoncology, Teledermatology, Telesurgery, E-Health and Cyber Medicine

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply multimedia technologies in telemedicine
- Explain protocols behind encryption techniques for secure transmission of data
- Apply telehealth in healthcare
- Plan strategies for Radiology department
- Validate the significance of various application in telemedicine

TEXTBOOKS:

1. Norris A C, " Essentials of Telemedicine and Telecare", John Wiley, New York, 2002
2. Huang H K, "PACS and Imaging Informatics: Basic Principles and Applications", Wiley New Jersey, 2010.

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REFERENCES:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", IOS Press, Netherland, 2002.
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, "PACS: A Guide to the Digital Revolution", Springer, New York, 2002.
4. Khandpur R S, "Telemedicine – Technology and Applications", PHI Learning Pvt Limited, New Delhi

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20BM815PE **BODY AREA NETWORKS (Common to BME and ECE)** **L T P C 3 0 0 3**

OBJECTIVES:

The student should be made to:

- Know the basics of Body Area Networks & its challenges
- Learn the Hardware requirements like Processors
- Understand the wireless communication and security aspects in the BAN
- Understand the concepts of Interferences transceiver & regulatory power source issues & virus problems
- Know the applications of BAN in the field of medicine

UNIT I INTRODUCTION **9**

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

UNIT II HARDWARE FOR BAN **9**

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

UNIT III WIRELESS COMMUNICATION AND NETWORK **9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEEP802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN **9**

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN **9**

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Comprehend and appreciate the significance and role of this course in the Contemporary world
- Design a BAN for appropriate application in medicine
- Assess the efficiency of communication and the security parameters
- Understand the need for medical device regulation in various countries
- Extend the concepts of BAN for medical applications

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TEXT BOOKS:

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

REFERENCES:

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

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BoS (BME)

20EC706PE	INTRODUCTION TO WIRELESS AND CELLULAR COMMUNICATION (COMMON TO BME AND ECE)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Depth understanding of the wireless channel and the related impairments
- An ability to evaluate the Classification of Signal Variation
- An understanding on signal propagation in cellular environment
- An ability to explain Antenna diversity, wireless Channel Capacity for Wireless Communication
- An ability to explain multiple access techniques for Wireless Communication

UNIT I INTRODUCTION **9**

Overview of Cellular Systems- 5G and other Wireless Technologies- Basic Cellular Terminology- Introduction to Antennas and Propagation Models- Link budget, Fading margin, Outage- Cellular Concept- Cellular system design and analysis- Cellular Geometry & System Design- Cellular System Capacity, Trunking Handoff & Mobility.

UNIT II CLASSIFICATION OF SIGNAL **9**

Classification of Signal Variation-- Shadowing, Outage, Multipath-- Rayleigh Fading and Statistical Characterization- Properties of Rayleigh Distribution- BER in Fading, Narrowband vs Wideband Channels- Characterization of Multipath Fading Channels- Choice of Modulation- Coherent versus Differential Detection- BER in Fading - Part II, Ricean Fading- Ricean and Nakagami Fading, Moment Generating Function (MGF)- MGF Part II, WSSUS

UNIT III CHARACTERISTICS OF CHANNELS **9**

WSSUS Part II, Coherence Time, Doppler Spectrum- Doppler, Temporal Characteristics of Fading Channels- Characterization of Time Dispersive Fading Channels- Classification of Fading Channels- Practical Channel Models (ITU, COST), Computer generation of Rayleigh fading- Rayleigh Fading simulation - Clark and Gans Method- Jakes Method.

UNIT IV DIVERSITY **9**

Introduction to Diversity, Antenna selection diversity-- Statistical Characterization of Antenna Diversity, Optimal Diversity Combining- BER in fading, Equal Gain Combining- Array Gain, Diversity Gain, Alamouti Scheme- Alamouti Scheme Part II, Channel Capacity- Capacity of fading Channels, Capacity with Outage- Channel State Information, Optimum Power Allocation- Optimum Power Allocation - Water filling.

UNIT V SPREAD SPECTRUM COMMUNICATIONS **9**

Intro to Direct Sequence Spread Spectrum Communications- Properties of Spreading Sequences- Introduction to CDMA- Features of cdma2000 and WCDMA- Rake Receiver for multipath channels- Multiuser environment- CDMA system Capacity- CDMA Multiuser

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Demonstrate an understanding on functioning of various example wireless communication systems, their evolution and standards.
- Understanding on signal propagation in cellular environment.
- Know about Classification of Signal Variation and fading.

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- Understand concepts of diversity and bit error rate in cellular communication
- Understanding on functioning of a spread-spectrum system and minimize the design challenges.

TEXT BOOKS:

1. Rappaport.T.S, "Wireless Communications – Principles and Practice", 2nd edition Pearson, 2010..

REFERENCES:

1. Molisch.A, "Wireless Communications," Wiley, 2005
2. Haykin & Moher, "Modern Wireless Communications" Pearson 2011 Indian Edition.
3. Proakis.J.G, "Digital Communications," McGraw Hill.
4. Goldsmith.A, "Wireless Communications," Cambridge Univ Press, 2005.
5. Tse.D and Viswanath.P, "Fundamentals of Wireless Communications," Cambridge Univ Press, 2005

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BoS/ECE

20BM812PE MODERN DIGITAL COMMUNICATION TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the evolution of digital networks
- Get acquainted with the fundamentals of digital communication
- Study the concept of signal characteristics
- Understand The Concepts Of Modulation Schemes
- Understand the applications Modern Digital Communication

UNIT I INTRODUCTION OF DIGITAL COMMUNICATION 9

Introduction to digital communication systems, Over view of Digital Communication, Source Coding, block diagram representation,

UNIT II SIGNAL CHARACTERISTICS 9

Characterization of Communication Signals & Systems, Signal space Representation, Representation of Memory less Modulation Methods.

UNIT III VARIOUS METHODS IN DIGITAL COMMUNICATION 9

Nonlinear modulation methods, optimal receivers of AWGN, Receiver for non-ideal channel

UNIT IV MODULATION SCHEMES 9

Probability of error of different modulation schemes, Fundamentals of estimation and detection theory used in digital communication

UNIT V CHANNEL ESTIMATION TECHNIQUES 9

Carrier phase and symbol timing synchronization techniques Channel estimation and equalization techniques, Power Adaptation methods for colored noise channel

TOTAL: 45 PERIODS

OUTCOMES:

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

- Comprehend and appreciate the significance and role of this course in the present Contemporary world.
- Design a BAN for appropriate application in medicine.
- Assess the efficiency of digital communication.
- Understand the need of modulation schemes in various regions.
- Extend the concepts of Channel Estimation Techniques.

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TEXT BOOK:

1. John G. Proakis, "Digital Communications".

REFERENCES:

1. Bernard Sklar, "Digital Communications".
2. Robert Gallager, "Digital Communications".
3. Simon Haykin, "Digital Communications".
4. B.P. Lathi.Modern, "Digital and Analog communications".

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20BM501PE	BIO MEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn various MEMS materials and fabrication techniques
- Understand different types of mechanical and thermal sensors and actuators and their principles of operation at the micro scale level
- Study the electrostatic and piezoelectric sensors and actuators
- Appreciate various microfluidic systems
- Know the application of MEMS in different field of medicine

UNIT I MEMS MATERIALS AND FABRICATION **9**

Typical MEMs and Microsystems, materials for MEMS active substrate materials-Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, Quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS **9**

Mechanics for MEMs design – static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators – actuator based on thermal expansion, thermal couples, thermal resistor, shape memory alloys – Inertia sensor, flow sensor.

UNIT III ELECTROSTATIC, PIEZOELECTRIC SENSORS AND ACTUATORS **9**

Parallel plate capacitor; pull in effect, Electrostatic sensors and actuators – Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor.

UNIT IV MICROFLUIDIC SYSTEMS **9**

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps – continuous flow system, micromixers.

UNIT V APPLICATIONS OF BIOMEMS **9**

CAD for MEMS, Drug delivery, micro total analysis systems (Micro TAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA sensor, MEMS based drug delivery, Biosensors – sensors for glucose, uric acid, urea and triglyceride sensor.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Discuss various MEMS fabrication techniques
- Explain mechanical and thermal sensors and their principles of operation at the micro scale level
- Describe the electrostatic, piezoelectric sensors and actuators
- Appraise the microfluidic systems with its advantages
- Apply MEMS in different field of medicine

TEXT BOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Wanjun Wang and Stephen A Soper, "BioMEMS: Technologies and Applications", CRC Press, New York, 2007.

REFERENCE BOOKS:

1. Marc J Madou, "Fundamentals of Microfabrication: The Science of Miniaturization", CRC Press, 2002.
2. Nadim Maluf and Kirt Williams, "An Introduction to Microelectro Mechanical Systems Engineering", Second Edition, Artech House Inc, MA, 2004.
3. Chang Liu, "Foundations of MEMS", Pearson Education International, New Jersey, USA, 2006.
4. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007.

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20BM702PE ROBOTICS IN MEDICINE

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the basics of Robotics and Kinematics
- Identify the basic knowledge of Inverse Kinematics
- Investigate the Robot Vision representation and the associated operations
- Explore various kinematic motion planning solutions for various Robotic configurations
- Explore various applications of Robots in Medicine

UNIT I INTRODUCTION **9**

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 II KINEMATICS **9**

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, Workspace fixtures, Pick and Place operations, Continuous path motion, Interpolated motion, Straight line motion

UNIT III ROBOT VISION **9**

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 IV PLANNING **9**

Task planning, Task level programming, Uncertainty, Configuration, Space, Gross motion, Planning, Grasp Planning, Fine motion planning, Simulation of planar motion, Source ad Goal scenes, Task Planner simulation

UNIT V APPLICATIONS **9**

Applications in Biomedical Engineering – Bio Engineering, Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopedics, Neurosurgery

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the basics of Robotic Systems
- Design basic Robotic Systems and Formulate Kinematics
- Construct Inverse Kinematic motion planning solutions for various Robotic configurations
- Describe the strategies of planning and the goals of motion
- Design Robotic systems for Medical application

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TEXT BOOKS:

1. Robert Schilling, "Fundamentals of Robotics – Analysis and Control", Prentice Hall, 2003
2. Craig J J, "Introduction to Robotics", Pearson Education, 2005.

REFERENCES:

1. Staugaard, Andrew C, "Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning", Prentice Hall of India, 1987
2. Grover, Wiess, Nagel, Oderey, " Industrial Robotics: Technology, Programming and Applications", McGraw Hill, 1986
3. Wolfram Stadler, "Analytical Robotics and Mechatronics", McGraw Hill, 1995
4. Saeed B Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001
5. Fu K S, Gonzales R C and Lee C S G, "Robotics", McGraw Hill, 2008.

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BoS/BME

20BM703PE ADVANCED DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS **L T P C 3 0 0 3**

OBJECTIVES:

The student should be made to:

- Understand the devices used in ICU and principles of Telemetry
- Describe types of diathermy and its uses
- Demonstrate applications of ultrasound in medicine
- Explain extracorporeal devices used in critical care
- Discuss the importance of patient safety against electrical hazard

UNIT I PATIENT MONITORING AND BIOTELEMETRY **9**

Patient monitoring systems, ICU/CCU Equipments, Bed side monitors, Infusion pumps, Central consoling controls. Radio Telemetry (Single, Multi), Portable and Landline Telemetry Unit, Applications in ECG and EEG Transmission

UNIT II DIATHERYMY **9**

IR AND UV lamp and its application, Short wave diathermy, Ultrasonic diathermy, Microwave diathermy, Electro surgery machine – Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures

UNIT III ULTRASONIC EQUIPMENTS **9**

Diagnosis: Tissue Reaction, Basic principles of Echo technique, Display techniques A B and M mode, B Scan, Application of Ultrasound as diagnostic tool – Echocardiogram, Echoencephalogram, Abdomen, Obstetrics and Gynecology and Ophthalmology

UNIT IV EXTRAC CORPOREAL DEVICES AND SPECIAL DIAGNOSTIC TECHNIQUES **9**

Need for heart lung machine, Functioning of bubble, Disc type and Membrane type Oxygenators, Finger pump, Roller pump, Electronic monitoring of functional parameters. Hemo Dialyser Unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laproscopy, Otoscopes, Thermography – Recording and Clinical application

UNIT V PATIENT SAFETY **9**

Physiological effects of Electricity – Important susceptibility parameters – Macro shock –Micro shock hazards – Patient's electrical environment – Isolated power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Discuss the various equipment used in ICU and applications of telemetry
- Explain the types of diathermy and its applications
- Express the basics of ultrasound and its application in medicine
- Discuss the various extracorporeal and special diagnostic devices used in hospitals
- Outline the importance of patient safety against electrical hazard

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TEXT BOOKS:

1. John G Webster, "Biomedical Instrumentation Application and Design", Fourth Edition, Wiley India Pvt Ltd, New Delhi, 2015.
2. Joseph J Carr and John M Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2012.

REFERENCES:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Second Edition, Prentice Hall of India, New Delhi, 2015.
2. Richard Aston, "Principles of Applied Biomedical Instrumentation and Measurement", Merril Publishing Company, 1990
3. Geddes L A and Baker L E, "Principles of Applied Biomedical Instrumentation", Third Edition, John Wiley and Sons, 2004
4. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
5. Khandpur R S, "Handbook of Biomedical Instrumentation", Third Edition, Tata McGraw Hill, New Delhi, 2014.

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20BM505PE	BIOMEDICAL LASER INSTRUMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the LASER radiation characteristics and interaction of LASERS with tissues
- Study the types, construction and operation of different LASER systems
- Get familiarized with the role of different types of LASER systems used for biomedical applications
- Understand the applications of LASER in Opthalmology, Dermatology, Urology, Gynecology and Neurology
- Appreciate the applications of LASER in Orthopaedic surgery, Dentistry and precautionary methods in LASER safety

UNIT I LASER TISSUE INTERACTION **9**

Principle and Fundamentals of LASER – LASER radiation and its characteristics – Mutual interaction process – Primary and Secondary factors – Biological tissue composition – Light penetration and reflectance – LASER medicine domains – LASER light scattering in tissues – Speckle formation – Interference and Polarization methods of tissue diagnostics – Alterations of Bio tissue properties during hyperthermal and ablation reactions, Photodynamic therapy.

UNIT II TYPES OF LASER USED IN MEDICINE **9**

Types of LASER – Construction and working principle of Solid State LASER - Atomic LASER - Molecular LASER – Liquid Dye LASER – Diode LASER – Solid state Dye LASER.

UNIT III LASER APPLICATIONS – I **9**

Applications of LASER radiation in ophthalmology – LASER treatment for eye tissues and diseases – LASERs in dermatology – handling pain – Dermatological disorders – LASERS in cardiovascular diagnostics – LASERs in cardiovascular therapy.

UNIT IV LASER APPLICATIONS – II **9**

LASERs in Urology – LASER stone disintegration – LASERs treatment for benign prostatic hyperplasia, Bladder neck incision – Bladder tumor and Upper urinary tract – LASERs in Laparoscopy – LASERs in Laryngeal surgery – LASERs in Otology – LASERs in Neurology.

UNIT V LASER IN ORTHOPAEDIC SURGERY, DENTISTRY & SAFETY **9**

Mechanism of bone and cartilage reparation – LASERS in Orthopaedic surgery – LASER techniques used in spinal surgery – LASERs in dentistry – LASERs in Endodontic procedures – Caries detection and treatment by LASER radiation – LASER bleaching – Types of LASER Hazards, LASER safety, LASER use risk management.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the LASER radiation characteristics and interaction of LASERS with tissues
- Explain the types, construction and operation of different LASER systems
- Associate the role of different types of LASER systems used for biomedical applications
- Understand the applications of LASER in ophthalmology, Dermatology, Urology, Gynecology and Neurology
- Attain the knowledge on applications of LASER in Orthopaedic surgery, Dentistry and precautionary methods in LASER safety

TEXT BOOKS:

1. Helena Jelinkova, "LASERs for Medical Applications: Diagnostics, Therapy and Surgery", Woodhead Publishing, First Edition, 2013.

REFERENCE BOOKS:

1. Markolf H Neimz, "LASER Tissue Interactions – Fundamentals and Applications", Springer, Third Edition, 2014.
2. Orazia Svelto and David C Hanna, "Principles of LASERs, Springer, 5th Edition 2010.
3. William T Silfvast, "LASER Fundamentals", Cambridge University Press, 2nd Edition, 2009.

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BoS (BME)

20BM816PE **CRITICAL CARE EQUIPMENT** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand various intensive care equipment and its functions
- Learn the equipments and its functions of critical care equipments
- Understand the necessity of different operation theatre equipment
- Know about the necessity of various centralized systems
- Develop necessary awareness about various standards and safety measures need to be taken for patients

UNIT I NTENSIVE CARE UNIT EQUIPMENT **9**

Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. 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

UNIT II CRITICAL CARE EQUIPMENT **9**

Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators.

UNIT III OPERATION THEATRE EQUIPMENT **9**

Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyles apparatus. Endoscopy – Laparoscopy - Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, surgical microscope.

UNIT IV CENTRALISED SYSTEMS **9**

Centralized Oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.

UNIT V PATIENT SAFETY **9**

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.

TOTAL:45 PERIODS

OUTCOMES:

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

- Apply the knowledge acquired, in designing new monitoring devices for ICU and assist the medical personnel's during emergency situations
- Suggest suitable surgical instruments and operational devices required in the critical care unit
- Assess the merits of the operation theatre equipment based on its applications

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BoS (BME)

- Appreciate the necessity of having centralized system for Oxygen, Nitrogen, Theater table and lighting
- Discuss about the patients safety requirements and hazards

TEXT BOOKS

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India PvtLtd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012.
3. Khandpur. R.S., "Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co.,Ltd. 2003.

REFERENCES

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2. Antony Y.K.Chan,"Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

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20BM817PE	HUMAN ASSIST DEVICES (Common to BME and ECE)	L T P C 3 0 0 3

OBJECTIVES:

- Study the role and importance of machines that takes over the functions of the heart and lungs,
- Study various mechanical techniques that help a non-functioning heart.
- Learn the functioning of the unit which does the clearance of urea from the blood
- Understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- Study about recent techniques used in modern clinical applications

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART **9**

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT II CARDIAC ASSIST DEVICES **9**

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT III ARTIFICIAL KIDNEY **9**

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS **9**

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT V RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students will be able to:

- Explain the principles and construction of artificial heart
- Demonstrate various mechanical techniques that improve therapeutic technology
- Explain the functioning of the membrane or filter that cleanses the blood.
- Describe the tests to assess the hearing loss and development of wearable devices for the same.
- Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

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TEXT BOOKS:

1. Gray E Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc New York, 2004.
2. John. G . Webster, " Bioinstrumentation", John Wiley & Sons (Asia) Pvt Ltd, 2004.
3. Joseph D.Bronzino, "The Biomedical Engineering Handbook", 3rd Edition: Three Volume Set, CRC Press, 2006.

REFERENCES:

1. Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 1980.
2. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

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20BM806PE MICROELECTRONICS: DEVICES TO CIRCUITS **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the basic concepts of bipolar junction transistors
- Explain the operation of field effect transistors
- Understand the concepts of differential amplifier
- Analyze the behavior of various amplifier circuits
- Compare the operation of combinational and sequential logic circuits

UNIT I BIPOLAR JUNCTION TRANSISTOR **9**

Physical structure and modes of operation – BJT operation in active mode, circuit symbol and conventions – BJT as an amplifier, small circuit model – BJT small signal circuit model – BJT as a switch and Ebers moll model – Simple BJT inverter and second order effects.

UNIT II FIELD EFFECT TRANSISTORS **9**

MOS transistor basics – MOS parasitic and SPICE model – CMOS inverter basics – Power analysis – Logical efforts – Fabrication process – Biasing of amplifier and its behaviour as an analog switch – CMOS CS/CG /CD amplifier configuration – Internal CAP models and high frequency modelling – JFET, structure and operation.

UNIT III DIFFERENTIAL AMPLIFIER **9**

Multistage and differential Amplifier – MOS differential amplifier – Small signal operation and differential amplifiers – Multistage amplifier with SPICE simulation.

UNIT IV ANALYSIS OF AMPLIFIERS **9**

S–Domain analysis, Transfer function, Poles and zeros – High frequency response of CS and CE amplifier – High frequency response of CC and SF configuration – Frequency response of differential amplifier – General Feedback Structure and properties of negative Feedback. Basic Feedback Topologies – Design of feedback amplifier for all configuration – Stability and amplifier poles – Bode plots and frequency plot.

UNIT V COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN **9**

Ideal operational amplifier and its terminal – Op–amp as a Integrator and Differentiator – Large signal operation of Op–amp and second order effects – Combinational logic design – Sequential logic design – Clocking strategies for sequential design – Memory design.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Know the model of bipolar junction transistors
- Understand the basic operation of field effect transistors
- Explain the operation of differential amplifier
- Summarize the behavior of various amplifier circuits
- Design combinational and sequential logic circuits

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BoS/BME

TEXT BOOK:

1. Rabaey, Chandrakasan and Nikolic, "Digital Integrated Circuit A Design Perspective", Fourth Edition, Pearson, 2011.

REFERENCES:

1. Weste and Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley, Latest Edition.
2. Streetman B G and Banerjee S, "Solid State Electronic Devices", 6th Edition, Prentice Hall, 2009.
3. Sedra and Smith, Microlectronics Circuits, Oxford University Press, 1998.

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BoS/BME

20EC809PE	ENCLOSURE DESIGN OF ELECTRONICS (COMMON TO BME AND ECE)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Sensitise a registrant to various aspects of an electronics product.
- Specifically on non electrical aspects like mechanical design and detailing.
- Starting from a need translated into specifications.
- Leading to design and prototyping
- Ending up in a manufacturable physical prototype

UNIT I INTRODUCTION **9**

Introduction to Products, Industrial Design and Product design, Types of products ID as per ICSID and WIPO -Creativity in Product Design, Needs vs features, Product conceptualization -Sketching basics, sketching as a design tool, Using illustration software.

UNIT II PACKAGING AND ENCLOSURES **9**

Role of packaging and enclosures, Use of IP approved sets, Design of Purpose built enclosures-Physical simulation of a small system, Basics of building a prototype mock up, Skills and specification in alternate materials -Use of off the shelf electronics system, Gumstix, Beagle, RasberryPi, Arduino, Kit application. Adaption for I / O.

UNIT III DEVELOPMENT TOOLS **9**

Development of Enclosures with Laser tools, Use of Flat plastics, Product specific Enclosure design, Application of CAD tools (dessault, siemens, Autodesk, McNeil), Design for FDM (3d printing), Specifics of Design for Production Scale-up.

UNIT IV I/O INTERFACES **9**

Design of I/O interfaces Front panel layout and graphics Heat sink enclosures, Detailing of Built in Heat sink boxes, Connector basics, Common connectors, MIL C connectors- Basics of ergonomis - Connection and wiring, Integration and Validation

UNIT V MANUFACTURING DOCUMENTATION **9**

Detailing and manufacturing enclosures using CAD: Detailing with CAD, Integrating Products with CAD, Product Detailing, Components CAD Physical Models, Applicability for industrial specific dealing-Sheet Metal and Plastic common details, Sourcing and logistics of hardware, Area for specification-Sample of Simple Organic Shapes.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand need of electronics product design
- Design of Package and enclosures
- Understand the development tools
- Study the details of I/O interfaces.
- Knowledge about preparation of manufacturing documentation

TEXT BOOK:

1. Prof. N. V. Chalapathi Rao, "Enclosure design of Electronics Equipment", IISC, Bangalore.

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27/1/22.

20MA601PE QUANTITATIVE AND REASONING APTITUDE

(Common to all branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The Student should be made to:

- Sense the problems and develop strategies to find the solutions.
- Derive conclusions and make decision by analyzing mathematical functions.
- Build the right decision quantitatively based on the situations that depends upon the factors.
- Evaluate the validity and possible biases in the arguments presented in authentic contexts based on multiple sources of quantitative information.
- Do aptitude actively such as analyzing data, constructing hypotheses, solving problems, reflecting on their work and making connections.

UNIT I QUANTITATIVE ANALYSIS ON NUMBERS AND PERCENTAGE 9

Numbers - Simplification – H.C.F and L.C.M of Numbers – Square Root and Cube Root – Surds and Indices – finding Unit and Last two digits of given expression – Remainder Theorem - Average -Logarithm - Percentage – Profit, Loss and Discount.

UNIT II ANALYSIS ON EFFICIENCY, TIME AND SPEED 9

Simple Interest – Compound Interest - Time and Work – Pipes and Cistern – Chain rule - Time, Speed, Distance – Trains - Boats and streams- Races and games – Calendar -Clocks - Crypt arithmetic Problems.

UNIT III ANALYTICAL THINKING ABILITY OF RATIO & PROPORTION AND PROBABILITY 9

Ratio and Proportion -Problems on Ages – Partnership – Alligation or Mixture - Permutation and Combination – Probability - Height and Distance – Trigonometry–Mensuration (Two dimensional and Three dimensional figures) - Data Interpretation.

UNIT IV REASONING ABILITY – I 9

Series Completion – Coding and Decoding - Odd man out - Blood Relations - Sequential output Tracing – Analogy – Direction Sense Test - Classification - Ranking - Seating Arrangements - Dice – Cubes and Cuboids.

UNIT V REASONING ABILITY – II 9

Syllogism – Statement and Conclusion -Statement and Assumption – Cause and effect - Transformation of Matrices - Matrix Reasoning - Mirror and Water Image – Paper folding – Completion of incomplete pattern- Embedded Images.

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Solve a real-time problem which requires interpretation and comparison of complex numeric summaries.
- Get reason, models, and draw the conclusions or make decisions with mathematical, statistical and quantitative information.
- Justify and communicate effectively with conclusions in the appropriate ways to the audience.
- Apply probabilistic reason to draw conclusions, to make decisions, and to evaluate outcomes of decisions.
- Perceive success in future courses, gain skills for the workplace, and participate as a productive citizens in society.

TEXT BOOKS:

1. Aggarwal R S, "Quantitative Aptitude for Competitive Examinations", S Chand Publishing; New Delhi, Revised edition, 2017.
2. Aggarwal R S, "A Modern Approach to Verbal and Non – Verbal Reasoning", S Chand Publishing; New Delhi, Revised edition, 2018.

REFERENCES:

1. Abhijit Guha, "Quantitative Aptitude for All Competitive Examinations", McGraw Hill Education; 6th edition, 2016.
2. Arun Sharma, "How to Prepare for Quantitative Aptitude for the CAT", McGraw Hill Education; 8th edition, 2018.
3. Kailash Chandra and Sunil Kumar, "General Intelligence and Reasoning (Verbal and Non – Verbal)", Arihant Publications, 13th edition, 2019.
4. Anand P A and Lalith Singh, "Wiley's Verbal Ability and Reasoning for Competitive Examinations", 2016.

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20CS201	PYTHON PROGRAMMING	L T P C
	(Common to AD, BME, CSE, ECE, EEE and IT)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Acquire knowledge about the fundamentals of Python language.
- Learn about Control flow and functions in Python language.
- Develop programs using object oriented programming concepts.
- Use Python data structures like lists, tuples and dictionaries.
- Build application that handles files and exceptions.

UNIT I INTRODUCTION TO PYTHON 9

Programming Languages - Python History - Getting Started with Python - Writing a Simple program - Reading input from console - Identifiers - Variables, Assignment Statements and Expressions - Simultaneous Assignments - Named Constants - Data Types and Operators - Evaluating expressions - Augmented Assignment operators - Type conversion - Common Python Functions - Strings and Characters - Objects and Methods - Formatting Numbers and Strings.

UNIT II CONTROL STATEMENTS AND FUNCTIONS 9

Selections: if - Two way if-else - Nested if and Multi-way if-elif-else Statements - Logical Operators - Conditional Expressions - Operator Precedence and Associativity - Loops: while - for - Nested Loops - break and continue - Function: Definition - Calling and Returning values - Positional and keyword arguments - Passing arguments by reference values - Modularizing Code - Scope of variables - Default Arguments - Function Abstraction and Stepwise Refinement - Recursion.

UNIT III OOP CONCEPTS IN PYTHON 9

Object and classes - Defining classes for objects - UML Class diagram - Immutable Objects vs. Mutable Objects - Hiding data fields - Class abstraction and encapsulation - Object-Oriented Thinking - The str Class - Inheritance and Polymorphism: Super classes and Sub classes - overriding methods - Object class - Polymorphism and Dynamic Binding - The insistence Function - Class Relationships.

UNIT IV DATA STRUCTURES IN PYTHON 9

List Basics - Copying Lists - Passing List to Functions - Returning a List from function - Searching Lists - Multidimensional Lists - Tuples - Sets - Comparing Sets and Lists - Dictionaries.

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UNIT V FILES AND EXCEPTION HANDLING 9

Introduction - Text Input and Output - File Dialogs - Retrieving Data from the Web - Exception Handling - Raising Exceptions - Processing Exception using Exception Objects - Defining Custom Exception Classes.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the basics of python programming languages.
- Apply the concepts of Control flow and functions to build applications.
- Build solutions using the concepts of object oriented programming.
- Design applications using data structures for real-time problems.
- Develop programs by using files and exception handling for the given scenario.

TEXT BOOKS:

1. Y. Daniel Liang , "Introduction to Programming Using Python", Pearson Education, 2013.

REFERENCES:

1. Timothy A. Budd, "Exploring Pyhton", McGraw Hill Education (India) Private Ltd, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Mark Lutz, "Learning python", O'Reilly Publication, 5th edition, 2013.
5. Guido Van Rossum and Fred L. Drake Jr, "An Introduction to Python", Revised and updated for Python 3.2, Network Theory Ltd., 2011.

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20BM704PE SOFT COMPUTING METHODS FOR BIOMEDICAL **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the different soft computing methods
- Understand neural network architectures and learning algorithms for different applications
- Explore the use of Fuzzy and Genetic Algorithm
- Understand different Optimization techniques in soft computing
- Realize Hybrid and other advanced model in soft computing

UNIT I INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS **9**

Biological Neural Networks, Components of Artificial Neural Networks-– Connections, Propagation function and Network Inputs, Common Activation Functions, Threshold-Network Topologies, Learning – Supervised, Unsupervised, Reinforcement, Back Propagation, Radial Basis Function, Self Organizing Maps, Counter Propagation Networks, Adaptive Resonant Theory (ART)

UNIT II FUZZY SET THEORY **9**

Introduction to Fuzzy – Fuzzy Sets – Basic Definition and Terminology – set-Theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If – Then Rules – Fuzzy Reasoning – Fuzzy Interference Systems – Mamdani Fuzzy Models – Surgeno Fuzzy Models – Tsukamoto Fuzzy Models– Input Space Partitioning and Fuzzy Modelling

UNIT III GENETIC ALGORITHM **9**

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness Function, Population, Building Block hypothesis and schema theorem. Genetic Algorithms operators methods of selection, crossover and mutation, simple GA (SGA) other types of GA, Generation gap, Steady state GA.

UNIT IV OPTIMIZATION USING SOFT COMPUTING **9**

Single variable optimization – Region Elimination Methods, Fibonacci search Method, Multivariable Optimization – Cauchy's Steepest Descent Method, Newton's method, Swarm Intelligence – Particle Swarm Optimization, ANT Intelligence – ANT Colony Optimization, Artificial Bee Colony Algorithm, Jumping Frog Optimization

UNIT V HYBRID AND ADVANCED MODEL IN SOFT COMPUTING **9**

Genetic Algorithm based Back propagation Network, Fuzzy Logic Controlled Genetic Algorithms, Neuro Fuzzy Hybrid systems, Support Vector Machine, Extreme Learning Machine (ELM), Extended ELM, Random Forest Algorithm

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the relativity of Biology to Artificial Neural Networks
- Explain the fundamentals of Fuzzy sets, models and reasoning
- Clarify the importance of Genetic Algorithms with different algorithms
- Demonstrate the soft computing techniques applied in optimization
- Implement Neural, Genetic and Fuzzy algorithms for various applications

TEXT BOOKS:

1. Jang J S R, Sun C T and Mizutani E, "Neuro Fuzzy and Soft Computing", Pearson Education, 2004.
2. James A Freeman and David M Skapra, "Neural Networks: Algorithms, Applications and Programming Techniques", Addison Wesley, 1991, Digital Version, 2001.

REFERENCES:

1. LaureneFausett, "Fundamentals of Neural Networks – Architectures, Algorithms and Applications", Prentice Hall, 1994.
2. Simon O Haykins, "Neural Networks: A Comprehensive Foundation, Second Edition, Pearson, 1994.
3. Zimmermann H J, "Fuzzy set theory and its Applications" Springer International Edition, 2011.

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20CS401	COMPUTER NETWORKS	L T P C
	(Common to AD, BME, CSE, ECE, EEE and IT)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the protocol layering and physical level communication.
- Be familiar with the Data Link layer.
- Gain the knowledge on network protocols, Architectures and applications.
- Examine the functionalities on TCP and UDP.
- Interpret the knowledge on application layer.

UNIT I INTRODUCTION **9**

Data Communications – Data Flow – Networks – Networks types - The Internet – Standards – Network Models– TCP/IP Protocol Suite - The OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT II DATA LINK LAYER & MEDIA ACCESS **9**

Introduction – Link-Layer Addressing – Block Coding - Cyclic Coding - Checksum - DLC Services –Data-Link Layer Protocols – HDLC – Media Access Control - Wired LANs: Ethernet – Wireless LANs: IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III NETWORK LAYER **9**

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV TRANSPORT LAYER **9**

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V APPLICATION LAYER **9**

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the Layered Architecture of Computer Networks.
- Conceptualize the protocols of Data Link Layer and can build Local area networks.
- Apply Subnet and Supernet concepts in the construction of computer network.
- Summarize the protocols used in Transport Layer, QoS and Congestion control mechanisms.
- Analyze different protocols of Application Layer.

TEXTBOOK:

1. Behrouz A. Forouzan, "Data Communications and Networking", Fifth Edition TMH, 2013.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.
5. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

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20BM818PE **EMBEDDED SYSTEMS AND IoT** **L T P C**
2 0 2 3

OBJECTIVES:

The objective of this course is to enable the student to:

- Acquire knowledge and understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
- Understand the hardware architecture and features of embedded microcontrollers and peripherals.
- Understand programming aspects of embedded system design.
- Understand IoT architecture and Build simple IoT Systems using embedded target boards.
- Understand IoMT infrastructure for healthcare applications.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN **6**

Introduction to embedded processors- Application Areas- Categories of embedded processors- Challenges in Embedded System Design, Design Process- Requirements- Specifications- Hardware architecture- Software architecture-CISC & RISC Architectures. CPU Bus- Bus Protocols- Bus Organisation, Memory Devices

UNIT II PERIPHERAL INTERFACING **6**

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 III EMBEDDED SYSTEM SOFTWARE DESIGN **6**

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.

UNIT IV DESIGN AND DEVELOPMENT OF IOT **6**

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 / Arduino)

UNIT V INTERNET OF MEDICAL THINGS **6**

Case studies – Novel Symmetrical Uncertainty Measure (NSUM) Technique for Diabetes Patients, Healthcare Monitoring system through Cyber-physical system, An loT Model for Neuro sensors, AdaBoost with feature selection using loT for somatic mutations evaluation in Cancer.

30 PERIODS

LIST OF EXPERIMENTS

1. Interface LED with Aurdino and write an embedded C program to turn on / off LED
2. Interface Buzzer with Aurdino and write an embedded C program to turn on / off Buzzer with specified delay.

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3. Interface LED with Raspberry Pi and write an embedded C program to turn on / off LED
4. Interface Buzzer with Raspberry Pi and write an embedded C program to turn on / off Buzzer with specified delay.
5. Interface DC motor with Aurdino and write an embedded C program to turn on motor if push button is pressed.
6. Develop simple application to interface DHT11 sensor with and write a program to display temperature humidity readings using Aurdino.
7. Develop simple application to testing infrared sensor with IoT Applications using open platform and NODEMCU.

30 PERIODS
TOTAL: 60 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

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

REFERENCES:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009.
2. David E.Simon, Addison Wesley, "Embedded Software Primer", ISBN-13: 978 0201615692.
3. Barry B.Brey, "The Intel Microprocessors, Architecture, Programming and Interfacing" 6th Edition, Pearson Education.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
6. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand.
7. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014.

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20BM711PE ARTIFICIAL INTELLIGENCE SEARCH METHODS FOR PROBLEM SOLVING

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the prologue of Artificial Intelligence, agents and its applications
- Know about the fundamental search methods and the ways of using it
- Identify different algorithms with its relevant implementation
- Further add the existing conditions available on algorithms
- Learn the expert systems along the algorithms of different methods

UNIT-I INTRODUCTION TO ARTIFICIAL INTELLIGENCE **9**

Introduction - Overview and Historical Perspective - Principle of AI - Types of AI - Turing Test - Physical Symbol Systems and the scope of Symbolic AI, Agents Application and Agents - Future of AI.

UNIT-II BASIC SEARCH METHODS **9**

State Space Search: Depth First Search-Breadth First Search-DFID-Heuristic Search: Best First Search-Hill Climbing-Linear-Binary-Jump-Interpolation-Beam Search

UNIT-III ZONE BASED SEARCH **9**

Traveling Salesman Problem - Tabu Search - Simulated Annealing - Population Based Search - Genetic Algorithms - Ant colony Optimization - Branch and Bound - Algorithm A - Admissibility of A.

UNIT-IV SEARCHING ALGORITHM **9**

Monotone Condition – IDA – RBFS – Types-Sequence Alignment-Pruning Open and Closed in A-Problem Decomposition-Algorithm AO-Game Playing – Algorithms – Min max–Alpha Beta-SSS.

UNIT-V EXPERT SYSTEMS **9**

Rule Based Expert Systems - Interference Engine-Rete Algorithm - Planning: Forward/Backward Search - Goal Stack Planning – SSS man's Anomaly - Plan Space Planning - Algorithm Graph plan.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe Artificial Intelligence with its core purpose of utilizing in solving real world problems
- Apply the different search methods to find solutions to the intended issues
- Appraise the importance of various algorithms to different domains
- Relate the search methods to arrive at the required results
- Demonstrate the significance of expertise to bring out the appreciable outcome

TEXT BOOK:

1. Rajendra Akerkar, "Introduction to Artificial Intelligence: Modern Approach", Pearson Education, Third Edition, 2014.

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REFERENCE BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence A Modern Approach", Pearson Education, Third Edition, 2014.
2. Richard E Neapolitan, Xia Jiang, "Artificial Intelligence with an Introduction to Machine Learning", Second Edition, CRC Press, Second Edition, 2018.
3. Nils J Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmaan Publishers, Inc, 2009
4. Andries P Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, Second Edition, 2007.
5. John Fulcher, Lakshmi C Jain, "Computational Intelligence: A compendium, Studies in Computational Intelligence", Vol. 115, Springer 2008.

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20CE501PE	INDUSTRIAL WASTE MANAGEMENT (Common to AGE, BME, ECE, EEE, CSE, IT, Mech)	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the various characteristics of industrial waste water.
- Learn the process and mechanism of different waste water treatment process.
- Impart awareness on waste that emits from industries.
- Gain knowledge on biological waste water treatment process.
- Familiarize with treatment of sludge and its disposal methods.

UNIT I INTRODUCTION 9

Undesirable waste water characteristics – Characteristics of industrial waste waters – Waste water characteristics – Estimating the organic content – Measuring the efficiency toxicity – In plant waste control and waste reuse – Storm water control.

UNIT II WASTE WATER TREATMENT PROCESSES 9

Pre and primary treatment of waste water – Equalization – Neutralization – Sedimentation – Oil separation-sour water strippers – Floatation – Coagulation, precipitation and metals removal– coagulation – Heavy metals removal – Aeration and mass transfer; mechanism of oxygen transfer – Aeration equipment – Air stripping of volatile organic compounds.

UNIT III POLLUTION FROM MAJOR INDUSTRIES 9

Sources, Characteristics, waste treatment flow from industries such as Textiles, pulp and paper mill wastes breweries and distilleries waste, Tanneries, Pharmaceuticals, Dairy, Sugar mill wastes, Steel plants, oil Refineries, fertilizer plant waste, petrochemical complex waste, corn starch industry waste – Odour and its removal-removal color from waste waters – Waste minimization and clean technologies.

UNIT IV BIOLOGICAL WASTE WATER TREATMENT PROCESS 9

Lagoons and stabilization basins – Aerated lagoons-activated sludge processes – Trickling filtration – Rotating biological contactors – Anaerobic decomposition-laboratory evaluation of

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anaerobic treatment – Adsorption – Theory of activated carbon – Sludge quality considerations – Stripping of volatile organics – Nitrification and denitrification.

UNIT V SLUDGE TREATMENT AND DISPOSAL **9**

Characteristics of sludge for disposal – Aerobic digestion – Gravity thickening – Flotation thickening – Rotatary drum screen – Gravity belt thickener – Centrifugation – Vacuum filtration – Pressure filtration – Belt filter press – Sand bed drying-factors affecting dewatering performance – Land disposal of sludges – Incineration.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain knowledge on undesirable waste water characteristics.
- Understand various methods dealt with treatment of waste water.
- Learn various sources, types, characteristics and disposal methods of industrial waste water.
- Acquire knowledge on different types of aerobic and anaerobic waste water treatment process.
- Aware with various sludge treatment methods and its disposal.

TEXT BOOKS:

1. Wesley Eckenfelder W, Jr Industrial Water Pollution Control 3rd Edition, Mc–GrawHill Book Company, New Delhi, 2000.
2. Stephenson R L and Blackburn J B, Industrial Wastewater Systems Hand book, Lewis Publisher, New York, 1998.

REFERENCE BOOKS:

1. M.N.Rao & A.K.Dutta, Wastewater Treatment, Oxford - IBH Publication, 1995.
2. H.M. Freeman, Industrial Pollution Prevention Hand Book, McGraw-Hill Inc., New Delhi, 1995.

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20CE502PE	AIR POLLUTION AND CONTROL ENGINEERING	L	T	P	C
	(Common to AGE, BME, ECE, EEE, CSE, IT, Mech)	3	0	0	3

OBJECTIVES:

The student should be made to:

- Impart knowledge on ambient air quality and emission standards.
- Learn effects of meteorology on air pollution.
- Understand various types of particulate contaminants with its sources and control measures.
- Gain awareness on different types of gaseous contaminants and its preventive measures.
- Study various sources, types and control of indoor air pollutants.

UNIT I INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT II METEOROLOGY 9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT III CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

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UNIT V INDOOR AIR QUALITY MANAGEMENT 9

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control- Sources and Effects of Noise Pollution – Measurement – Standards – Control and Preventive measures.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the nature and characteristics of air pollutants.
- Analyze the fundamentals on effects of meteorology in air pollution.
- Design stacks and particulate air pollution control devices to meet applicable standards.
- Learn control devices of gaseous contaminants with design standards.
- Maintain indoor quality management.

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C Stern, "Air Pollution (Vol. I – Vol. VIII)", Academic Press, 2006.
3. Wayne T Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc., 2000.
4. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers Pvt. Ltd., India 2002.

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BME

20CS506OE FUNDAMENTALS OF SOFTWARE ENGINEERING **L T P C**

(Common to BME, CIVIL, ECE, EEE and MECH) **3 0 0 3**

OBJECTIVES:

The Student should be made to:

- Explore the fundamental concepts of software engineering
- Learn the requirements engineering process and planning for software development
- Understand the software design principles
- Know coding standards and different testing strategies
- Learn the project management principles and quality assurance standards

UNIT I SOFTWARE AND SOFTWARE ENGINEERING **8**

The Nature of Software - Software Engineering - Software Myths – Process Models: Prescriptive Process Models, Specialized Process Models, Personal and Team Process Models – Overview of Agile Process -Overview of CMMi

UNIT II REQUIREMENTS ENGINEERING AND PLANNING **10**

Requirements Engineering: Establishing the Groundwork - Eliciting Requirements - Negotiating Requirements - Validating Requirements - Requirements Analysis using scenario based modeling. Process and Project Metrics: Software Measurement - Metrics for Software Quality. Estimation: The Project Planning Process – Resources - Software Project Estimation - Decomposition Techniques - Empirical Estimation Models - Project Scheduling

UNIT III MODELLING AND DESIGN **9**

Modelling: Data Modeling Concepts - Class-Based Modeling - Flow-Oriented Modeling - Creating a Behavioral Model Design Concepts - Architectural Design: Software Architecture, Architectural Styles, Architectural Design, Architectural Mapping Using Data Flow - User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis

UNIT IV CODING AND SOFTWARE TESTING **9**

Coding standards and guidelines - Testing: Strategic approach to Software Testing - Test Strategies for Conventional Software - Validation Testing - System Testing – Debugging – White-box Testing - Basis Path Testing - Control Structure Testing - Black-box Testing

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UNIT V PROJECT MANAGEMENT AND SOFTWARE QUALITY 9

Project Management Concepts: The Management Spectrum, People, Product and Process – Software Configuration Management – Risk Management - Quality Management: Software Quality, Achieving Software Quality - Elements of Software Quality Assurance - The ISO 9000 Quality Standard

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply software engineering principles for software development.
- Formulate software requirement specification and plan for software development
- Design software according to the specification
- Code the software using guidelines / standards and conduct testing
- Manage and maintain the software process by assuring the quality

TEXT BOOKS:

1. Roger S. Pressman and Bruce R. Maxim, "Software Engineering – A practitioner's approach", McGraw Hill Publications, Eighth Edition, 2014

REFERENCES:

1. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, Third Edition, 2005
2. Ian Sommerville, "Software engineering", Pearson Education Asia, Seventh Edition, 2007.
3. Watts S.Humphrey, "A Discipline for Software Engineering", Pearson Education, 2007.
4. James F.Peters and WitoldPedrycz, "Software Engineering, Engineering Approach", Wiley-India, 2007.
5. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill, 2007.
6. S.A.Kelkar, "Software Engineering", Prentice Hall of India Pvt, 2007

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BoS (CSE)

20CS507OE	INTRODUCTION TO DATA STRUCTURES AND ALGORITHMS (Common to BME, CIVIL, EEE and MECH)	L T P C 3 0 0 3

BME

OBJECTIVES:

The Student should be made to:

- Introduce the basics of problem solving techniques and analysis of algorithms
- Learn the various searching and sorting techniques
- Impart knowledge on ADTs such as List, Stack, Queue
- Explore the binary trees and priority queues
- Get exposure on hashing techniques and graphs

UNIT I ANALYSIS OF ALGORITHMS **9**

Introduction to Algorithms and algorithmic problem solving – Problem types. Analysis of Algorithms: Analysis Framework - Asymptotic Notations – Best case, worst case and average cases - Mathematical analysis of non-recursive algorithms - Recurrence equations – Solving recurrence equations - Mathematical analysis of recursive algorithms.

UNIT II SEARCHING AND SORTING ALGORITHMS **9**

Search Algorithms: Linear search - binary search - Analysis of Search algorithms. Sorting Algorithms: Bubble sort - Exchange sort - Insertion sort – Merge sort – Quick sort – Heap sort - Analysis of Sorting Algorithms.

UNIT III LISTS, STACKS AND QUEUES **9**

Abstract Data Types – The List ADT – Singly Linked List – Doubly Linked List – Circular Linked List – Applications and analysis of List. The Stack ADT – Applications and Analysis of Stack. The Queue ADT – Applications and Analysis of Queues.

UNIT IV TREES AND HEAPS **9**

Preliminaries – Binary Trees – Expression Trees- Traversals. The Search Tree ADT – Binary Search Trees – Applications of BST. Priority Queues – Binary heap – Heap operations - Applications of heaps.

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UNIT V HASHING AND GRAPHS 9

Hashing – Closed hashing: Separate Chaining – Open Addressing - Linear probing. Graph ADT – Representation of graph – Graph Traversals: DFS and BFS. Applications of Graph - Finding Shortest Path - Connected components.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Analyze recursive and non recursive algorithms for complexity
- Apply various searching / sorting algorithms for solving real-world problems
- Implement List, Stack and Queue with appropriate data structures
- Work with binary trees and heap based priority queue
- Exploit the hashing technique and graph algorithms

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education Asia, Second Edition, 1997.

REFERENCES:

1. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, "Data Structures and Algorithms", Pearson Education, New Delhi, 2006
2. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, "Fundamentals of Data Structures in C", Orient Longman, Second Edition, 2008.
3. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw-Hill, New Delhi, Second Edition, 1991.

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20EC501OE	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Student should be made to:

- Understand the concepts of measurement and characteristics of transducers
- Learn the various sensors used to measure various physical parameters
- Apply the concept of sensors for force, magnetic and heading sensor
- Explain the concept of optical, pressure and temperature sensors
- Distinguish the DAQ systems with different sensors for real time applications

UNIT I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types- First order and Second order Transducer systems.

UNIT II MOTION AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – Light Detection and Ranging (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gauge, Load Cell and Magnetic Sensors – types and principle –Magnetoresistive – Hall Effect – Eddy Current sensor- Heading Sensors: Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE TEMPERATUREAND SMART SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure: Diaphragm, Bellows, Piezoelectric – Temperature – Thermistor, RTD, Thermocouple. Acoustic Sensors: Flow and level measurement, Radiation Sensors – Smart Sensors – MEMS and Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging – applications – Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Expertise in various calibration techniques and signal types for transducers
- Understand the basic principles of various motion and ranging sensors
- Analyze the various sensor in force, heading and temperature applications
- Apply the various sensor applications in optical, pressure, temperature and smart sensor
- Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems-Applications and Design", Tata McGraw Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai and Co, New Delhi, 12th Edition, 2013.

REFERENCES:

1. Patranabis D, "Sensors and Transducers", PHI, New Delhi, 2nd Edition ,2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook", CRC Press, 2nd Edition ,2015.
4. Dr Sengolrajan T and Sampath A, "Sensors and Transducers", Sri Krishna Hitech Publishing Company Pvt. Ltd, 1st Edition, 2019.
5. Dr Vijayachitra S, "Transducer Engineering", PHI Learning Pvt. Ltd, 1st Edition, 2016.

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20EC503PE	INTERNET OF THINGS (COMMON TO BME, CIVIL, ECE, EEE AND MECH)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the fundamentals of Internet of Things
- Study about domain specific IoTs & M2M
- Design the IoT using Python
- Build a small low cost embedded system using Raspberry Pi
- Apply the concept of internet of things in the real world scenario

UNIT I INTRODUCTION TO IoT **9**

Internet of Things – characteristics- Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - IoT Platforms Design Methodology.

UNIT II DOMAIN SPECIFIC IoTs & M2M **9**

Domain Specific IoTs- M2M- Difference between IoT & M2M- Software Defined Networking- Network Function Virtualization.

UNIT III IoT LOGICAL DESIGN USING PYTHON **9**

Introduction –Python Data types & Data structures-Control Flow-Functions-Modules-Packages-File Handling-Classes-Python Packages of Interest for IoT.

UNIT IV IoT PHYSICAL DEVICES & ENDPOINTS **9**

IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Devices – Arduino.

UNIT V CASE STUDIES **9**

Home Automation – Cities – Environment – Agriculture - Structural Health monitoring - Weather monitoring.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the concepts of Internet of Things
- Analyze the domain specific applications of IoT
- Apply the knowledge of Python for IoT
- Design a portable IoT using Rasperry Pi
- Implement basic IoT applications on embedded platform

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

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REFERENCES:

1. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
3. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

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20EE501OE NON-CONVENTIONAL ENERGY RESOURCES L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Acquire knowledge on various sources of non-conventional energy
- Learn the fundamental concepts about solar energy systems and devices
- Design wind turbine system and know about facts of wind energy in electricity generation
- Understand the geothermal and biomass energy system
- Discuss other energy sources

UNIT I INTRODUCTION **9**

Electric energy from conventional sources – Energy reserves – Power scenario in India – Types of renewable energy sources – New technologies of energy resources – Impact on renewable generation on environment – Biochemical cycles – Global warming potential – Forest resources and water management in India – Biodiversity.

UNIT II SOLAR ENERGY **9**

Solar radiation – Geometry, Estimation and Measurements – Solar thermal energy storage – Solar thermal electric power plant – Solar ponds – Solar air heaters – Solar cookers – Solar air conditioning and refrigerators – Solar greenhouse – Solar photovoltaic system and its standards – Application of PV system – PV hybrid system.

UNIT III WIND ENERGY **9**

Classification of wind turbines and rotors – Terms used in wind energy – Wind energy characteristics – Land for wind energy – Design of wind turbine rotor – Modes of wind power generation – Estimation of wind energy potential – Wind resource assessment in India – Grid system and properties.

UNIT IV GEOTHERMAL AND BIOMASS ENERGY **9**

Structure of Earth's interior – Geothermal resources and its power generation – Biomass resources – Biomass conversion technology – Biochemical conversion – Biomass gasification – Biogas and its plant – Power generation from liquid waste – Biomass cogeneration – Biodiesel – Biofuel petrol.

UNIT V OTHER ENERGY SOURCES **9**

Tidal energy: Tidal characteristics – Tidal energy and its potential estimation – Development of tidal power scheme – important component of tidal power plant – Tidal power development in India. Wave Energy: Factors affecting the wave energy – Mathematical analysis of wave energy – Principle of wave energy plant – Wave energy conversion machines. Ocean Thermal Energy Conversion (OTEC): Working Principle – Closed cycle OTEC system – Thermoelectric OTEC – Application and global development.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Demonstrate the various causes of renewable energy sources with environmental aspect
- Illustrate the concept of solar energy technology
- Analyze the techniques used in wind energy sources
- Know the classification and operation of geothermal and biomass sources
- Enumerate the details of other energy sources

TEXT BOOK:

1. Kothari P, Singal K C and Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Pvt. Ltd., New Delhi, 2011.

REFERENCES:

1. Godfrey Boyle, "Renewable Energy - Power for a Sustainable Future", Oxford University Press, U.K, 1996.
2. Twidell J W and Weir A, "Renewable Energy Sources", EFN Spon Ltd., UK, 1986.
3. Tiwari G.N, "Solar Energy – Fundamentals Design", Modelling and Applications, Narosa Publishing House, New Delhi, 2002.
4. Shobh Nath Singh, "Non-Conventional Energy Resources", Pearson Education, 2015.
5. Scott Grinnell, "Renewable Energy and Sustainable Design", Cengage Learning, USA, 2016.

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20EE502OE	INDUSTRIAL AUTOMATION	L T P C 3 0 0 3

OBJECTIVES:

The student should be made to:

- Acquire knowledge on industrial automation systems
- Illustrate the field level equipment's in industrial automation
- Develop basic programming with PLC
- Understand the theory and operation of SCADA system
- Design a industrial application based problems

UNIT I INTRODUCTION **9**

Industrial control system – Automation and process control – Purpose of industrial automation – Industrial automation circuits – Computer based industrial control and automation – Architecture of the basic three level integrated industrial automation systems – Distributed control system.

UNIT II FIELD LEVEL EQUIPMENTS **9**

Sensors: Thermal overload relay – Proximity and photoelectric switch – Limit, level and flow switches – Temperature and pressure switch. Actuators: Electric motors – Pneumatic actuators – Micro Electro Mechanical System – Solenoid linear actuators – Different types of relays – Timers, Drum switches and special components – Pneumatic devices.

UNIT III PROGRAMMABLE LOGIC CONTROLLERS **9**

Introduction to PLCs – Modular construction of PLC – PLC I/O components – I/O modules – Special purpose of I/O modules – Central processing unit – PLC expansion and I/O configuration – Introduction to programming of PLCs – Basic programming instructions – PID control in the industry.

UNIT IV HMI AND SCADA **9**

HMI controls for data acquisition – Developer and runtime packages – Available tools – Definition of tags – Display of real time parameters in graphical form – Generation of various reports – Logging of alarms, trend curves and historical reports.

UNIT V COMMUNICATION PROTOCOLS **9**

Serial and Parallel communication – Communication topology – Field bus and similar standards – RTU/MTU communications.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain knowledge on the basics of industrial automation system
- Understand the working of different field level equipments
- Analyze the theory and operation of PLC programming instructions
- Impart the knowledge of SCADA system
- Develop various industrial automation applications

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TEXT BOOKS:

1. Stamatios Manesis and George Nikolakopoulos, "Introduction to Industrial Automation", CRC Press, 2018.
2. Stuart A Boyer, "SCADA: Supervisory Control and Data Acquisition", 4th Edition, ISA Press, USA, 2009.

REFERENCES:

1. John W Webb and Ronald A Reis, "Programmable Logic Controllers: Principles and Applications", Prentice Hall India, 2003.
2. William Bolton, "Programmable Logic Controllers", Elsevier, Sixth Edition, 2015.
3. Gupta A K, "Industrial Automation and Robotics: An Introduction", Mercury Learning & Information, 2016.
4. Krishna Kant, "Computer Based Industrial Control", Second Edition, Prentice Hall of India, 2010.
5. Popovic D and Bhatkar V P, "Distributed Computer Control for Industrial Automation", Marcel Dekkar Inc., Newyork, 1990.

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20ME601OE	PRODUCTION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Identify and select suitable materials for various engineering applications
- Understand the concept of metal casting process
- Know about the various types of welding processes
- Understand the working principles of machine tools such as Lathe, Shaping, Milling, Drilling and Grinding
- Learn about the basic concepts of Computer Numerical Control (CNC) machine tool

UNIT I ENGINEERING MATERIALS **9**

Engineering Materials – Classification – Mechanical properties of materials – strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability and weldability – Steels and Cast irons : Carbon steels – classifications based on percentage of carbon – properties and applications – Alloy steels: Stainless steel and tool steel.- Cast iron and its types.

UNIT II METAL CASTING PROCESSES **9**

Sand Casting : Sand mould – Type of patterns – Pattern materials – Pattern allowances – Moulding sand properties – Core – Moulding machines – Types and applications; Melting furnaces : Blast and Cupola furnaces; Principle of special casting processes: Shell – investment – Ceramic mould – Pressure die casting – Centrifugal casting - Stir casting; Defects in sand casting.

UNIT III WELDING **9**

Introduction, classification of welding processes – Gas welding, types of flames and applications. Electric arc welding, Resistance welding, Soldering and Brazing processes and their uses.

UNIT IV MACHINING **9**

Centre lathe – Constructional features – Specifications – Operations performed – Special machines: Shaper, Drilling, Milling and Grinding machines – Constructional details and its operations.

UNIT V CNC MACHINE **9**

Numerical Control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy – Structural members – Slide ways – Linear bearings – Ball screws – Spindle drives and feed drives.

TOTAL: 45 PERIODS

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BoS (MECH)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain knowledge on engineering materials
- Know about the casting process and its defects
- Understand the construction and working principles of gas, arc welding and resistance welding process
- Identify the suitable machining process for the given component
- Describe the constructional and operational features of CNC machines

TEXT BOOKS:

1. Kalpakjian and Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2014.
2. Hajra Choudry S K, "Elements of Workshop Technology-Vol. II", Media Promoters and Publishers Pvt. Ltd, 2010.

REFERENCES :

1. Nagendra Parashar B S and Mittal R K, "Elements of Manufacturing Processes", Prentice Hall of India, 2011.
2. Rao P N, "Manufacturing Technology, Metal Cutting and Machine Tools", Tata McGraw Hill, New Delhi, 2013.
3. Chapman W A J, "Workshop Technology", Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London, 2004.

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BoS (MECH)

20ME602OE	BASICS OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the various engine components of automobiles
- Illustrate the different types of transmission system used in automobiles
- Study the construction of various engine auxiliary systems
- Learn about working principles of steering, suspension and braking systems
- Describe about the fundamentals of alternative energy sources and Ignition

UNIT I ENGINE COMPONENTS **9**

Overview – Engine Components – Engine block, Crank shaft, Connecting rod, Cylinder Liners, Piston, Piston rings, Cylinder head – Camshaft, Valve, Rocker Arm, Spark Plug, Injector, Carburetor, Fuel pump.

UNIT II TRANSMISSION COMPONENTS **9**

Flywheel – Clutch – Friction plate, Clutch housing, Pressure plate. Gearbox – Propeller shaft – Differential – Conventional Differential, Rear axle.

UNIT III BODY COMPONENTS **9**

Types of automobiles – Vehicle construction and different layouts, Chassis, Frame and body – Vehicle aerodynamics.

UNIT IV STEERING, SUSPENSION SYSTEMS AND BRAKES **9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS).

UNIT V ALTERNATIVE FUELS AND IGNITION SYSTEMS **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles. Ignition System – Battery and Magneto Ignition System – Principles of Combustion and detonation CI Engines. Lubrication and Cooling systems.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Recognize the various parts of the automobile and their functions
- Distinguish the working of different types of power transmission systems like clutch, gears
- Demonstrate the Vehicle construction and Vehicle aerodynamics
- Explain about the Steering, Brakes and Suspension systems
- Predict possible alternate sources of energy and ignition system for automotive Engines

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TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering", Vol. 1 and 2, Seventh Edition, Standard Publishers, New Delhi, 14th Edition 2017.
2. Ganesan V, "Internal Combustion Engines", Tata McGraw-Hill, 4th Edition, 2018.

REFERENCES:

1. Joseph Heitner, "Automotive Mechanics," East-West Press, Second Edition, 1999.
2. Jain K K and Asthana R B, "Automobile Engineering", Tata McGraw Hill Publishers, New Delhi, 2002.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals", The Good Heart-Will Cox Company Inc, USA , 1978.

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BoS (MECH)

20IT501OE FUNDAMENTALS OF OPERATING SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

The Student should be made to:

- Acquire basic knowledge of operating system structures and its functioning
- Study the concept of process management
- Learn the basics of memory management
- Understand the structure of file systems
- Familiarize with different operating systems

UNIT I OPERATING SYSTEMS OVERVIEW **9**

Introduction to operating systems – Computer system organization – architecture – Operating system structure – operations – Process, memory, storage management – Open source operating systems – OS services – User interface – System calls – System programs – Process concept – scheduling – Operations on processes – Cooperating processes – Inter-process communication – Threads.

UNIT II PROCESS MANAGEMENT **9**

Basic concepts – Scheduling algorithms – Algorithm evaluation – The critical section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – Deadlocks – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock.

UNIT III MEMORY MANAGEMENT **9**

Memory management – Swapping – Contiguous memory allocation – Paging – Segmentation – Virtual memory: Background – Demand paging – Copy on write – Page replacement – Allocation of frames – Thrashing.

UNIT IV FILE MANAGEMENT **9**

File concept – Access methods – Directory structure – File-system mounting – Protection – Directory implementation – Allocation methods – Free space management – Disk scheduling – Disk management.

UNIT V LINUX AND WINDOWS **9**

The Linux system – History – Process management – Scheduling – Memory management – File systems – Inter Process Communication – Windows OS – History – Design principles.

TOTAL: 45 PERIODS

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BoS (IT)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Identify the components of operating system and their functionalities
- Analyze the various process management algorithms
- Evaluate the performance of various memory management techniques
- Design a simple file system and analyze the performance
- Work with some popular operating systems like Linux, Windows

TEXTBOOK:

1. Abraham Silberschatz, Peter B Galvin and Greg Gagne, "Operating System Concepts Essentials", John Wiley and Sons Inc., 8th Edition, 2011.

REFERENCE BOOKS:

1. Andrew S Tanenbaum, "Modern Operating Systems", Addison Wesley, 2nd Edition, 2001.
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education, 1996.
3. Dhamdhere D M, "Operating Systems: A Concept-based Approach", Tata McGraw Hill Education, 2nd Edition, 2007.
4. William Stallings, "Operating Systems: Internals and Design Principles", Prentice Hall, 7th Edition, 2011.

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20IT502OE	INTRODUCTION TO DATABASE	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Correlate the role of database management systems in information technology applications
- Structure data using relational model
- Explore the features of structured query language
- Reduce the anomalies using Normalization
- Manage transaction and concurrency control techniques

UNIT I DATABASE FUNDAMENTALS **9**

Purpose of Database Systems – View of Data - Database System Architecture – Database Users and Administrators – Data Models – Structure of Network Model – Structure of Hierarchical Model – Entity Relationship Model – Constraints – Removing Redundant Attributes in Entity Sets – E-R Diagrams – Design Issues – Extended E-R Features – Introduction of Relational Model – E-R Reduction to Relational Schemas

UNIT II RELATIONAL DATABASE MODEL **9**

Structure of Relational Databases – Database Schema – Schema Diagrams – Relational Query Languages – Relational Algebra – Tuple Relational Calculus – Domain Relational Calculus

UNIT III STRUCTURED QUERY LANGUAGE **9**

Overview of SQL query language – SQL Data definition – Basic Structure of SQL Queries – Additional Basic Operations – Set Operations – Null values – Aggregate Operations – Nested Subqueries – Joins – Views – Integrity Constraints – Authorization. Introduction to Advanced SQL: Functions and Procedures – Triggers

UNIT IV NORMALIZATION **9**

Functional Dependencies – Non-loss Decomposition – Dependency Preservation – First, Second, Third Normal Forms – Boyce Codd Normal Form

UNIT V TRANSACTION AND CONCURRENCY CONTROL **9**

Transaction Model – ACID properties – Transaction States – Serializability – Conflict serializability – View Serializability – Testing Serializability. Concurrency Control – Lock Based Protocols – Deadlocks – Multiple Granularity – Time Stamp Based Protocols – Validation Based Protocols.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Draw the ER Diagram for enterprise applications
- Design databases using relational model
- Query the database using SQL
- Apply normalization techniques on the databases
- Perform transaction and concurrency control techniques

TEXTBOOKS:

1. Henry F Korth, Abraham Silberschatz, Sudharshan S, "Database System Concepts", McGraw Hill, 6th Edition, 2011.
2. Date C J, Kannan A and Swamynathan S, "An Introduction to Database Systems", Pearson Education, 8th Edition, 2006.

REFERENCE BOOKS:

1. Elmasri R and Navathe S B, "Fundamentals of Database Systems", Pearson Education/Addison Wesley, 6th Edition, 2010.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2009.
3. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", McGraw Hill, 3rd Edition 2004.

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BME

20CE701OE	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Carry out developmental projects for environmental and social assessments.
- Explain Life Cycle Assessment and elements of waste minimization.
- Develop knowledge on various hazardous waste management.
- Learn industrial air emission control measures.
- Know about EIA for various infrastructure projects.

UNIT I INTRODUCTION 9

Definition & Concept-Hierarchy in EIA – Initial Environmental Examination (IEE) – Environmental Impact Statement (EIS) – Environmental appraisal – Rapid and Comprehensive EIA, EIS, FONSI and NDS – Need for EIA Studies – Advantages and limitation of EIA.

UNIT II METHODOLOGIES AND CLEARANCE PROCEDURE 9

Application Forms – Category of projects – Formation of EIA study team Methods of EIA – Criteria for selection of EIA methodology – Check lists – Matrices – Network – Overlays – Cost-benefits analysis – EIS format – Teams of Reference (ToR).

UNIT III ASSESSMENT AND PREDICTION 9

Baseline data – Assessment of Impact on land, water, air, noise, social, cultural, flora and fauna – Mathematical models – Predictive measures – Resettlement & rehabilitation – Public participation in EIA – EIA case studies for select projects.

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN 9

Environment audit – Types of audit – Definitions and concepts – Stage of environmental audit – compliance schedule – Contents of EA report – Preparation of audit report – Introduction to ISO and ISO 14000 – Environmental monitoring plan.

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UNIT V LEGISLATIONAND CASE STUDIES 9

The Environmental Protection Act, The Water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act – Case studies and preparation of Environmental Impact assessment statement for various Industries.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Prepare and review environment impact assessment for various projects.
- Apply waste minimization strategies and waste reduction techniques.
- Reduce the generation of hazardous waste with proper disposal methods.
- Design industrial air emission control equipments with its standards.
- Apply EIA for various multi disciplinary projects.

TEXT BOOKS:

1. Gerard Kiely, "Environmental Engineering", Tata Mcgraw Hill Education Private Limited, New Delhi 2007.
2. Shukla S K and Srivastava P R, "Concepts in Environmental Impact Analysis",Common Wealth Publishers, New Delhi 2010.

REFERENCE BOOKS:

1. Canter R. L, "Environmental Impact Assessment", McGraw Hill Inc, New Delhi, 2nd Edition 1996.

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R2ME

20CE702OE BUILDING SERVICES **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand how a building can be made comfortable and safe with the services designed and installed.
- Impart knowledge on basics of electrical wiring system.
- Recognize the importance of principles of illumination.
- Acquire awareness on various principles of refrigerant.
- Learn the principles on installation of fire safety components.

UNIT I MACHINERIES **9**

Introduction of lifts and Escalators –Special features required for lifting arrangement and installation – Travelators – Controls – Machine room and equipments.

UNIT II ELECTRICAL SYSTEMS IN BUILDINGS **9**

Basics of electricity distribution – Earthing systems and bonding – Electric wiring – Industrial installations – Lighting controls – Light sources, Lamps, Lighting design – Telecommunication installations.

UNIT III PRINCIPLES OF ILLUMINATION **9**

Ventilation requirements – Mechanical ventilation – Fans and types – Boilers and types – Water treatments – Solar heating of water – Hot water storage cylinders.

UNIT IV REFRIGERATION PRINCIPLES **9**

Heat emitters – Expansion facilities of heating system – Energy management system – Factors affecting fuels – Oil sand properties of natural gas – Air conditioning, principles and applications – Refrigerant and system characteristics – Heat recovery devices.

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UNIT V FIRE SAFETY INSTALLATION 9

Fire prevention and control systems – Fire alarms – Electrical alarm circuits –Smoke extraction and ventilation –Gas extinguishers – Types of detectors – Gas installation and components.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the special features in installation of lifts and escalators.
- Analyze basics of electricity distribution in buildings.
- Acquire knowledge about requirements of ventilation.
- Learn the principles of air conditioning and energy management system.
- Recognize the need for fire detection and protection.

TEXT BOOKS:

1. Roger Greeno and Fred Hall, "Building Services Handbook", Elsevier Publishers 4th Edition, 2007.

REFERENCE BOOKS:

1. Steffy G, "Architectural Lighting Design", John Wiley and Sons, 3rd Edition, 2008.
2. Killinger J and Killinger L, "Heating and Cooling Essentials", Goodheart Wilcox Publishers, 2003.
3. Rao S and P Saluja H L,
4. "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1st Edition, 2016.
5. Ashrae, "Fundamentals and Equipment", ASHRAE Inc., Volume 4, 2005.

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BoS(CIVIL)

20CS706OE	E-COMMERCE	L T P C
	(Common to BME, CIVIL, ECE, EEE and MECH)	3 0 0 3

BME

OBJECTIVES:

The Student should be made to:

- Study the basics of E-Commerce.
- Learn the activities involved in the E- commerce process.
- Focus the applications related to the EDI.
- Analyze the security issues in the E –commerce.
- Apply the E-commerce at various applications.

UNIT I INTRODUCTION 9

E-Commerce framework – E-Business models – Network infrastructure for E-commerce – Internet as a Network Infrastructure – E-commerce and World Wide Web.

UNIT II E-COMMERCE 9

Consumer oriented E-Commerce – Applications – Mercantile process models – Electronic Payment Systems – Digital Token based EPS – Smart cards – Credit cards – Risks – designing EPS – Study of e-commerce companies

UNIT III INTERORGANIZATIONAL COMMERCE AND EDI 9

Electronic Data Interchange: EDI applications in Business – EDI and E-Commerce – EDI standardization and implementation – Internet based EDI.

UNIT IV SECURITY ISSUES IN E-COMMERCE 9

Network Security – Client-Server Network Security – CS Security Threats – Firewalls – Data & Message Security – Encrypted Documents – Security on the Web.

UNIT V INTRAORGANIZATIONAL E-COMMERCE AND MARKETING 9

Internal Information System-Work-flow Automation and Coordination-Supply Chain Management-Document Library-Types of Digital Documents-Corporate Data Warehouses – Advertising and Marketing on the Internet .

TOTAL: 45 PERIODS

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BoS (CSE)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the basics of E-Commerce.
- Explain the activities involved in the E- commerce process.
- Develop the applications related to the EDI.
- Analyze the security issues in the E –commerce.
- Apply the E-commerce at various applications.

TEXT BOOKS:

1. Ravi Kalakota and Andrew B Whinston, "Frontiers of Electronic Commerce", Pearson Education Asia, 2009.

REFERENCES:

1. Marilyn Greenstein and Todd M Feinman ,"Electronic commerce: Security, Risk Management and Control", Tata McGraw-Hill , 2000.
2. Judy Strauss and Raymond Frost, "E Marketing", PHI, 2002.
3. Brenda Kienan, "Managing E Commerce Business", PHI, 2001.
4. Vivek Sharma and Rajiv Sharma, "Developing E Commerce Sites – an integrated approach", Pearson Education Asia, 2000.
5. Kamalesh K. Bajaj, "E-Commerce: The Cutting Edge & Business", Tata McGraw-Hill, 2003.

CHAIRMAN
BoS (CSE)

20CS708OE INTRODUCTION TO COMPUTER ORGANIZATION **L T P C**

(Common to BME, CIVIL and MECH) **3 0 0 3**

OBJECTIVES:

The Student should be made to:

- Have a knowledge on basic digital principles.
- Understand the basic structure and operation of a digital computer.
- Explore the basic processing unit
- Study the hierarchical memory system.
- Learn the pipelining architecture concepts.

UNIT I INTRODUCTION TO DIGITAL PRINCIPLES **9**

Boolean functions – Simplifications of Boolean functions using Karnaugh map-Implementation of Boolean functions using logic gates - Decoders and encoders - Multiplexers and demultiplexers

UNIT II BASIC STRUCTURE OF COMPUTERS **9**

Functional units – Basic operational concepts – Performance – Instructions and instruction sequencing – Addressing modes – RISC and CISC Styles – Arithmetic: Design of fast adders – Multiplication of unsigned and signed numbers – Fast Multiplication – Floating point numbers and operations.

UNIT III BASIC PROCESSING UNIT **9**

Fundamental concepts – Instruction Execution – Hardware Components - Instruction Fetch and Execution Steps – Control Signals – Hardwired control

UNIT IV MEMORY SYSTEM **9**

Basic concepts – Memory hierarchy - Semiconductor RAM – Read-only Memories – Direct Memory Access – Cache memories – Performance considerations – Virtual memory

UNIT V PIPELINING **9**

Basic concepts – Pipeline organization and issues – Data dependencies – Memory and branch delays – Performance evaluation

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Apply digital principle concepts to design logical circuits
- Design the arithmetic circuits for faster operations
- Analyze the main processing units of a computer.
- Analyze memory hierarchy and its impact on computer cost/performance.
- Design a pipeline for consistent execution of instructions with minimum hazards

TEXT BOOKS:

1. Carl Hamacher, ZvonkoVranesic, Safwat Zaky, and Naraig Manjikian, "Computer Organization and Embedded Systems", McGraw Hill Higher Education, Sixth Edition, 2011.
2. M.Morris Mano, "Digital Design", Pearson Education, 3rd Edition, 2007.

REFERENCES:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Elsevier, Third Edition, 2005.
2. "Computer Organization", ISRD Group, Tata McGraw Hill, 2006.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Sixth Edition, 2003.
4. Charles H.Roth, Jr. "Fundamentals of Logic Design", Jaico Publishing House, Cengage Earning, 4th Edition, 2005.
5. Donald D. Givone, "Digital Principles and Design", Tata McGraw-Hill, 2007.

CHAIRMAN
BoS (CSE)

20EC701OE CONSUMER ELECTRONICS **L T P C**
3 0 0 3

OBJECTIVES:

The students should be made to

- Understand the audio basics and devices
- Know the performance of different audio systems
- Understand the various television systems
- Learn the operation of TV receivers and video systems
- Gain the knowledge on basics of home/office appliances

UNIT I AUDIO FUNDAMENTALS AND DEVICES **9**

Basic characteristics of sound signal: level and loudness - pitch - frequency response - fidelity and linearity - Reverberation - Audio level metering - decibel level in acoustic measurement - Microphone: working principle - sensitivity - nature of response - directional characteristics - Types: carbon - condenser - crystal - electrets - tie-clip - wireless - Loud speaker: working principle - characteristic impedance - watt capacity - Types: electrostatic - dynamic - permanent magnet etc - woofers and tweeters - Sound recording: Optical recording - stereophony and multichannel sound - MP3 standard.

UNIT II AUDIO SYSTEMS **9**

Audio system: CD player, home theatre sound system, surround ,sound- Digital console: block diagram, working principle, applications - FM tuner: concepts of digital tuning, ICs used in FM tuner TDA 7021T - PA address system: planning, speaker impedance matching, Characteristics, power amplifier, Specification

UNIT III TELEVISION SYSTEMS **9**

Monochrome TV standards - scanning process - aspect ratio - persistence of vision and flicker - interlace scanning - picture resolution - Composite video signal: horizontal and vertical sync details - scanning sequence - Colour TV standards - colour theory - hue-brightness - saturation - luminance and chrominance - Different types of TV camera - Transmission standards:PAL system - channel bandwidth.

UNIT IV TELEVISION RECEIVERS AND VIDEO SYSTEMS **9**

PAL-D colour TV receiver - block diagram - Precision IN Line color picture tube - Digital TVs: LCD - LED - PLASMA - HDTV - 3D TV - projection TV - DTH receiver - Video interface: Composite - Component - Separate Video - Digital Video - SDI - HDMI Multimedia Interface - Digital Video Interface - CD and DVD player: working principles - interfaces.

UNIT V HOME / OFFICE APPLIANCES **9**

FAX and Photocopier - Microwave Oven: types - single chip controllers - wiring and safety instructions - technical specifications - Washing Machine: wiring diagram - electronic controller for washing machine – technical specifications - types of washing machine - fuzzy logic - Air conditioner and Refrigerators: Components features - applications - and technical specification - Digital camera and cam coder: pick up devices - picture processing - picture storage, lithium battery.

Total: 45 Periods

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OUTCOME:

On successful completion of this course, the students will be able to,

- Develop audio circuits
- Design the audio systems
- Familiarize with TV systems
- Analysis the fault identification in TV
- Familiarize in home/office appliances

TEXT BOOKS:

1. Bali S.P, "Connsumer Electronics", Pearson Education India, 2010 , Latest Edition.
2. Bali R and Bali S.P, "Audio Video Systems: Principle Practices & Troubleshooting", Khanna Book Publishing Co.(P) Ltd., Delhi, India, Latest Edition, 2010.

REFERENCES:

1. Gulati R.R, "Modern Television Practices", New Age International Publication (P) Ltd. New Delhi Year 2011, Latest Edition
2. Gupta R.G, "Audio Video Systems", Tata McGraw Hill, New Delhi, India 2010, Latest Edition
3. Whitaker Jerry & Benson Blair, "Mastering Digital Television", McGraw-Hill Professional, Latest Edition, 2010.
4. Whitaker Jerry & Benson Blair, "Standard Handbook of Audio Engineering", McGraw-Hill Professional, Latest Edition, 2010.

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BoS /ECE

20EC702OE	RFID AND FLEXIBLE SENSORS	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the basic principle of RFID system.
- Get knowledge on information processing through RFID system
- Learn the basics of readers, printers and protocols.
- Design for various applications testing software.
- Understand the principle and applications of flexible sensors

UNIT I INTRODUCTION AND RFID ARCHITECTURE 9

Case for RFID - Eras of RFID - applications - RFID Architecture - confluence of technologies - key functionalities- system components - systemic quality considerations - architecture guidelines - System Management.

UNIT II TAGS AND PROTOCALS 9

Basic tag capabilities - physical characteristics - power source - air interface - information storage and processing capacity - standards - protocol terms and concepts - how tags store data - singulation and anti-collision procedurestag features for security and privacy - learn to troubleshoot tag communications

UNIT III READERS, PRINTERS AND READER PROTOCOLS 9

Physical and logical components of RFID reader - parts of RFID printer and applicator - types of readers - layout for readers and antennas - configuring readers - parts of a reader protocol - vendor protocols - EPC global protocol overview - simple lightweight RFID reader protocol - future protocols.

UNIT IV MIDDLEWARE AND INFORMATION SERVICE 9

Motivations - logical architecture - application level events specification - commercial RFID middleware - RFID Data - EPC global network - object naming service - EPC information services.

UNIT V FLEXIBLE SENSORS 9

World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the principle of operation of various components of RFID system.
- Familiar with usage of tags and protocols

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BoS /ECE

- Explain about the working principle of readers, printers and reader protocols
- Apply the methodology in engineering applications like inventory management, material handling etc
- Know about the recent trends in flexible sensors

TEXT BOOK:

1. Himanshu Bhatt, Bill Glover, "RFID Essentials", O'Reilly Media publications, 2006 Approved by third Academic council.
2. Amin Rida and Manos M. Tentzeris, RFID-Enabled Sensor Design and Applications (Artech House Integrated Microsystems), 2011, 1st edition, Artech House Publishers, UK

REFERENCES:

1. Klaus Finkenzeller, "RFID Handbook", John Wiley & Sons, Ltd, 2010
2. Stephen B. Miles, Sanjay E. Sarma, John R. Williams, "RFID Technology and Applications", Cambridge University Press, 2008
3. Patrick J Sweeney, "RFID for DUMMIES", Wiley India Publications, 2005
4. Elaine Cooney, "RFID + The Complete review of Radio Frequency Identification", 1st ed., Delmar Cengage Learning 2007.

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BoS /ECE

20EE701OE	ENERGY STORAGE SYSTEMS (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand the basic concepts of energy storage devices
- Learn the performance of various types of batteries
- Explain the operation of fuel cells and ultracapacitors
- Analyse the application of energy storage devices
- Know the thermal and mechanical energy storage systems

UNIT I ENERGY STORAGE TECHNOLOGIES **9**

Introduction – Need of energy storage – Battery – Components of cells and batteries – Classification – Operation of a cell – Theoretical cell voltage, capacity and energy – Electrochemical principles and reactions: Cell polarization – Electrical double–layer capacity and ionic adsorption – Mass transport to the electrode surface – Factors affecting battery performance – Standards.

UNIT II PRIMARY AND SECONDARY BATTERIES **9**

Battery parameters and specification – Performance, charging and discharging – Storage density, energy density, classical and modern batteries: Zinc–chloride, Nickel cadmium, Leadacid, Nickel hydride and Lithium battery – Principle and working.

UNIT III ADVANCED BATTERIES FOR EV APPLICATIONS **9**

Ultracapacitors: Features – Basic principles of ultracapacitors – Performance of ultracapacitors – Mathematical model. Fuel cells: Operating principles – Characteristics – Polarization loss – Fuel cells technologies – Comparison of fuel cells, hybridization of energy storage systems.

UNIT IV APPLICATIONS OF BATTERIES **9**

Storage of solar – Greenhouse heating – Power plant application – Batteries in space – Storage in electric supply networks – Automotive application in hybrid and electric vehicles – Role of ultracapacitors in EVs.

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BoS (EEE)

UNIT V THERMAL AND MECHANICAL ENERGY STORAGE 9

Thermal energy storage – Energy storage in hydrogen – Energy storage in flywheels – Pumped hydro storage – Elastic energy storage – Applications.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the working of energy storage devices
- Differentiate the characteristics of various primary and secondary batteries
- Compare the operation of ultracapacitors and fuel cells
- Summarize the applications of batteries
- Explain the different energy storage techniques

TEXT BOOK:

1. Robert A Huggins, "Energy Storage–Fundamentals, Materials and Applications", 2nd Edition, Springer, 2016.

REFERENCES:

1. Ibrahim Dincer and Marc A Rosen, "Thermal Energy Storage: Systems and Applications", 2nd Edition, John Wiley and Sons, 2011.
2. Ru-shiLiuLei Zhang, Xueliang Sun, Hansan Liu andJiujun Zhang, "Electrochemical Technologies for Energy Storage and Conversion", Wiley publications, 2012.
3. Ali Emadi, Mehrdad Ehsani and John M Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2010.
4. Tetsuya Osaka and MadhavDatta, "Energy Storage Systems in Electronics", Gordon and Breach Science Publishers, 2000.
5. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, Taylor and Francis Group, 2011.

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BoS (EEE)

20EE702OE	ELECTRICAL SAFETY ENGINEERING (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Know the concepts of safety engineering
- Learn the various electrical hazards and safety equipment
- Analyze the grounding and bonding techniques
- Compare the safety methods for various electrical equipment
- Understand the various standards for proper maintenance of electrical equipment

UNIT I CONCEPTS IN SAFETY **9**

Introduction – Electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment – Indian electricity act and rules – Statutory requirements from electrical inspectorate – International standards on electrical safety – First aid – Cardio Pulmonary Resuscitation(CPR).

UNIT II ELECTRICAL HAZARDS AND SAFETY EQUIPMENTS **9**

Primary and Secondary hazards – Arc, blast and shocks – Causes and effects – Safety equipment – Person Protection Equipment(PPE), Head and eye protection, flash and thermal protection. Rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags and locking devices – Voltage measuring instruments – Proximity and contact testers – Safety electrical one line diagram – Electrician's safety kit.

UNIT III GROUNDING AND BONDING TECHNIQUES **9**

General requirements for grounding and bonding – Definitions – Grounding of electrical equipment – Bonding of electrically conducting materials and other equipment – Connection of grounding and bonding equipment – System grounding – Purpose of system grounding – Grounding electrode system – Grounding conductor connection to electrodes – Use of grounded circuit conductor for grounding equipment – Grounding of low voltage and high voltage systems.

UNIT IV SAFETY METHODS OF EQUIPMENT **9**

The six step safety methods – Pre job briefings – Hot–Work decision tree – Safe switching of

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power system – Lockout – Tag out – Flash hazard calculation and approach distances – Calculating the required level of arc protection – Safety equipment – Procedure for low, medium and high voltage systems – The one minute safety audit.

UNIT V SAFETY SCHEDULE AND MAINTENANCE 9

Safety related case for electrical maintenance – Reliability Centered Maintenance (RCM) – Eight step maintenance programme – Frequency of maintenance – Maintenance requirement for specific equipment and location – Regulatory bodies – National electrical safety code – Standard for electrical safety in work place – Occupational safety and health administration standards.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the basic concepts related to safety
- Describe electrical hazards and safety equipment
- Identify various grounding and bonding techniques
- Select appropriate safety method for low, medium and high voltage equipment
- Conduct proper maintenance of electrical equipment according to standards

TEXT BOOK:

1. John Cadick, Mary Capelli–Schellpfeffer, Dennis K Neitzel and Al Winfield, "Electrical Safety Handbook", 4th Edition, McGraw–Hill Education, 2012.

REFERENCES:

1. Mohamed El Sharkawi, "Electric Safety–Practice and Standards", CRC Press, 2014.
2. Maxwell Adams J, "Electrical Safety–A guide to the Causes and Prevention of Electric Hazards", 1st Edition, The Institution of Engineering and Technology, 1994.
3. Ray A Jones, Ray Jones and Jane G Jones, "Electrical Safety in the Workplace", 1st Edition, Jones and Bartlett Learning, 2000.
4. Fortham Cooper W, "Electrical Safety Engineering", 1st Edition, Butterworth and Company, London, 1998
5. Kimberly Keller, "Electrical Safety Code Manual", Elsevier, 2010.

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BoS (EEE)

20ME701OE	BASICS OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Students should be made to:

- Study the fundamentals of fluid power systems
- Understand the working of hydraulic pumps and actuators
- Know about control valves and accumulators in hydraulic systems
- Learn the various components of pneumatic and electro-pneumatic systems
- Identify the various trouble shoots in hydraulic and pneumatic systems

UNIT I FUNDAMENTALS OF FLUID POWER SYSTEMS **9**

Introduction – fluid power systems – types – components – properties of fluids – types of fluids – applications of Pascal's law – principle of hydraulic flow - laminar and turbulent flow – Reynolds's number – Darcy's equation – losses in valves and fittings – advantages and applications of fluid power – fluid power ANSI symbols.

UNIT II HYDRAULIC PUMP AND ACTUATORS **9**

Principles of hydraulic system – pumping theory – pump classification - gear pump, vane pump, piston pump – fluid power actuators – linear hydraulic actuators - single acting, double acting and special type – rotary actuators - gear, vane and piston motors – hydraulic cushioning.

UNIT III CONTROL COMPONENTS IN HYDRAULIC SYSTEMS AND ACCUMULATORS **9**

Directional Control Valve (DCV) - check valve, 3/2 DCV and 4/3 DCV – pressure control valve - pressure relief valve and pressure reducing valve – flow control valve - pressure compensated and non pressure compensated – mechanical servo valves – proportional valves – comparison of servo and proportional valve – accumulators – types - weight loaded, spring loaded and gas loaded accumulators – intensifier – intensifier press circuit.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS **9**

Principles of pneumatic system – properties of air – compressors – Filter, Regulator and Lubricator (FRL) unit – muffler – air control valves – pneumatic actuators – components of electrical control - switches, solenoids, relays and timers – electro pneumatic system - electro pneumatic circuits - reciprocation, sequencing and regenerative – introduction to fluidics.

UNIT V TROUBLE SHOOTING AND APPLICATIONS **9**

Hydraulic and pneumatic systems: Installation, selection, maintenance, troubleshooting and remedies – low cost automation – Case studies: Conveyor feed system, car parking barriers, pick and place robot.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the basic concepts of fluid power systems
- Describe the functions of various hydraulic pump and actuators
- Familiarize with different types of control valves and accumulators
- Understand the functions of pneumatic and electro pneumatic systems

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BoS (MECH)

- Analyse the various trouble shooting methods of hydraulic and pneumatic systems

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education India, 7th Edition, 2013.
2. Srinivasan R, "Hydraulic and Pneumatic Controls", Vijay Nicole, 3rd Edition, 2019.

REFERENCES:

1. Majumdar S R, "Oil Hydraulics Systems-Principles and Maintenance", Tata McGraw Hill, 2017.
2. Majumdar S R, "Pneumatic Systems-Principles and Maintenance", Tata McGraw Hill, 1st Edition, 2011.
3. Shanmugasundaram K, "Hydraulic and Pneumatic Controls", S.Chand & Co, 1st Edition, 2006.

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BoS (MECH)

20ME702OE	ALTERNATIVE ENERGY FUELS	L T P C 3 0 0 3

OBJECTIVES:

The Students should be made to:

- Familiarize with various sources of energies available in universe
- Study the methods of liquid fuel extraction
- Know the concepts of fuel cells and types
- Learn the properties and preparation techniques of biodiesel
- Understand the production techniques of nuclear energy

UNIT I INTRODUCTION TO ENERGY 9

World energy consumption – petroleum – natural gas – coal – nuclear energy – geo thermal energy – renewable energy - solar, wind, tidal, biomass and hydropower.

UNIT II LIQUID FUELS 9

Introduction to coal pyrolysis – char oil energy development process – TOSCOAL process – Lurgi-Ruhr gas process – occidental flash pyrolysis process – clean coke process – coalcon process.

UNIT III FUEL CELLS 9

Introduction – basic concepts – design characteristics – operation – thermal efficiency – cell voltage – fuel cell system – general description – fuel cell classifications – low temperature fuel cells - proton exchange membrane fuel cells and alkaline fuel cells – high temperature fuel cells - molten carbonate fuel cells and solid oxide fuel cells.

UNIT IV BIODIESEL 9

Introduction – transesterification process for biodiesel manufacture – pretreatment of oil – transesterification reaction in a biodiesel reactor – product and by-product separation – purification – properties of biodiesel – cetane number – calorific value – general physical properties of biodiesel – cold flow properties – material compatibility.

UNIT V NUCLEAR ENERGY 9

Nuclear fission and nuclear reactor physics – electricity generation from nuclear reactors – nuclear fuel cycle – types of reactors – advanced reactors and concepts – hydrogen production – nuclear waste disposal – nuclear fusion.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain the various sources of energy
- Demonstrate liquid fuel extraction through pyrolysis processes
- Understand the importance and design considerations of fuel cells
- Describe the process involved in the extraction of biodiesel
- Analyse the utilization and waste disposal of nuclear energy

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BoS (MECH)

TEXT BOOKS:

1. Sunggyu Lee, James G Speight, "Handbook of Alternative Fuel Technologies", CRC Press, Taylor & Francis Group, 2014.
2. Arumugam S Ramadhas, "Alternative Fuels for Transportation", Taylor & Francis, 2016.

REFERENCES :

1. Donald L Klass, "Biomass for Renewable Energy, Fuels and Chemicals", Elsevier-Academic Press, 1st Edition.
2. Sunggyu Lee, "Alternative Fuels", CRC Press, Taylor & Francis, 1st Edition.
3. Suresh M, Rajkumar S, Lakshminarayanan A K, "Alternative Energy Sources, Materials and Technologies", Trans Tech Publications Limited, 2015.

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BoS (MECH)

20IT701OE	PROGRAMMING IN JAVA	L T P C 3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn the fundamentals of object oriented programming in Java.
- Be familiar with the Object Oriented concepts in Java
- Be exposed to the usage of Arrays in Java programming
- Understand the mechanism in handling exceptions, Multithreading and I/O.
- Demonstrate the concepts of AWT, event handling used in GUI.

UNIT I INTRODUCTION **9**

Introduction to Java – History of Java – FOP versus OOP – OOOPs Concepts - Java Programming Paradigm – Features of Java Programming – Java Programming Environment – C vs Java - Tools available for Java Programming – Java Architecture - Data types and Character set – Variables - Identifiers – Keywords – Operators - A Simple Java Program – Analysis of the program – Command line input in Java – Input using Scanner class

UNIT II CLASS, OBJECT and INHERITANCE **9**

Class – Class Structure – Object declaration – Object Initialization - Declaring Multiple Classes - Adding methods to Class – Constructor – this Keyword – Multiple Constructors – Constructor Overloading - Control Statements – Inheritance – Method Overriding – Super Keyword – Abstract Class– final Keyword – Access Modifiers - Packages in Java – Interface – Iterator – Cloneable – Serializable – Comparable

UNIT III ARRAYS **9**

Array in Java: Creation of Array – Storing elements in Array – Processing elements in Array – 2D Array and 3D Array – Java Scope – Static Keyword – Static Variable – Static Method – Nested Class – Recursion

UNIT IV EXCEPTION HANDLING, MUTITHREADING AND I/O STREAMS **9**

Exception Handling - Multithreading –Thread – Life Cycle of Thread – Thread Control Methods – Thread Types – Thread Scheduling – Thread Synchronization - I/O Stream – Character Stream Class - Data Input Stream – Data Output Stream – File Handling - Java networking - JDBC - Connectivity

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BoS (IT)

UNIT V APPLET, AWT and SWING **9**

Java Applet Programming : Applet – Building an applet – Hosting an applet – Running an Applet – Basic Structure of an applet – Basic Methods in applet – Input passing to an Applet – Application Versus Applet – Applet Events – Basics of HTML – Applet Tag Properties - AWT Programming – Classes of AWT – Components – Methods – Containers – Event Handling – Classes – Interfaces - SWING: Introduction – Swing Components – Containers – Events - Hierarchy of Swing class

OUTCOMES:

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

- Explain the fundamentals of Java programming
- Use the concept of object oriented programming in Java
- Implement the mechanism of array and recursion.
- Develop applications for concurrent processing and I/O with exception handling.
- Build interactive GUI applications in Java programming

TEXT BOOK:

1. Hebert Schildt, "Java: The Complete Reference, Eleventh Edition", 7th Edition, McGraw-Hill, 2010.

REFERENCE(S):

1. Kathy Sierra, Bert Bates, "Head First Java", 2nd Edition, O'Reilly Media, Inc., 2005.
2. Y.Daniel Liang, "Introduction to Java Programming", 11th Edition, Pearson Education, 2017.
3. https://onlinecourses.nptel.ac.in/noc21_cs56/preview

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BoS (IT)

20IT702OE	WEB DESIGN	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Enhance the knowledge of how to develop a Web page using HTML
- Classify the various style and dimensions of CSS
- Design the web page using JavaScript
- Design the web page using DOM
- Implement the various approach of database connectivity

UNIT I INTRODUCTION **9**

Introduction to HTML – Benefits of HTML – Structure of an HTML Document, HTML Tags: Attributes – meta Elements – Linking – Lists- Tables- Forms- Form Elements- Form Attributes – Web services.

UNIT II CASCADING STYLE SHEETS **9**

Introduction to CSS - Inline Styles – Conflicting Styles- Style Sheets- Positioning Elements – Backgrounds –Dimensions- Text Flow- Media Types – Drop-Down Menu.

UNIT III SCRIPTING LANGUAGE **9**

Introduction to Scripting Language – Data Types - Variables – Expressions – Operators and Control Statements – Arrays – User Defined Functions – Events.

UNIT IV JAVASCRIPT OBJECTS **9**

JavaScript Objects: String – Math – Date – Boolean and Number – Window – Document – Document Object Model(DOM) – DOM Collections – Dynamic Styles.

UNIT V IMPLEMENTATION STRATEGIES **9**

Introduction to PHP: Basics – String Processing and Regular Expressions – Form Processing and Business Logic – Connecting to a Database – Using Cookies – Dynamic Content – Operator Precedence Chart – Database Connectivity: SQL: DDL – DML- MySQL: Creating Database in MySQL – Mini Project.

TOTAL: 45 PERIODS

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BoS (IT)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Identify different types of HTML tags, their functionality and attributes and learn the basics of web services
- Classify CSS to control the appearance of web pages and denote the background elements and media types
- Incorporate JavaScript variables, operators and functions in web pages and manipulate HTML forms to validate user inputs
- Demonstrate various JavaScript object models and create a web pages with dynamic style using JavaScript and DOM
- Demonstrate the database connectivity and simple PHP application program using web Server

TEXT BOOKS:

1. Paul Deitel, Harvey Deitel, Abbey Deitel, "Internet & World Wide Web: How to Program", 5th Edition, Pearson, 2011
2. KoGent Learning Solutions Inc., "Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and AJAX", Kindle Edition, Dreamtech Press, 2012.

REFERENCES :

1. Robert. W. Sebesta, "Programming the World Wide Web", 8th Edition, Pearson Education, 2015.
2. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education, 2007.
3. http://www.w3schools.com/

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20M101 **FINANCIAL MANAGEMENT**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Acquire the knowledge of the decision areas in finance.
- Learn the various sources of Finance.
- Study about capital budgeting and cost of capital.
- Learn on how to construct a robust capital structure and dividend policy.
- Study about the tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT **9**

Definition and Scope of Finance Functions - Objectives of Financial Management – Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II SOURCES OF FINANCE **9**

Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III INVESTMENT DECISIONS: **9**

Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting — Payback -ARR – NPV – IRR –Profitability Index.

Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION **9**

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure.

Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy.

UNIT V WORKING CAPITAL DECISION **9**

Working Capital Management: Working Capital Management - concepts - importance –Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

45 PERIODS

CHAIRMAN
BoS (IT)

COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain about the decision areas in finance.
- Discuss about the various sources of Finance.
- Work on capital budgeting and cost of capital.
- Construct a robust capital structure and dividend policy.
- Handle the tools on Working Capital Management.

TEXT BOOKS

1. M.Y. Khan and P.K.Jain Financial management, Text, Tata McGraw Hill, Ltd.
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd.

REFERENCES:

1. James C. Vanhorne, Fundamentals of Financial Management, PHI Learning.
2. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

CHAIRMAN
BoS (IT)

20M102 **FUNDAMENTALS OF INVESTMENT**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Study about the investment environment in which investment decisions are taken.
- Acquire knowledge on how to Value bonds and equities.
- Learn the various approaches to value securities.
- Study on how to create efficient portfolios through diversification.
- Learn the mechanism of investor protection in India.

UNIT I THE INVESTMENT ENVIRONMENT **9**

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES **9**

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS **9**

Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES **9**

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India

UNIT V INVESTOR PROTECTION **9**

Investor grievances and their redressal system, insider trading, investors' awareness and activism.

45 PERIODS

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COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities.
- Explain the various approaches to value securities.
- Create efficient portfolios through diversification.
- Discuss the mechanism of investor protection in India.

TEXT BOOKS

1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14th Edition, 2019.

REFERENCES:

1. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.
2. Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
3. ZviBodie, Alex Kane, Alan J Marcus, PitabusMohanty, Investments, McGraw Hill Education (India), 11 Edition(SIE), 2019

CHAIRMAN
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20M103 **BANKING, FINANCIAL SERVICES AND INSURANCE**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Study about the Banking system in India.
- Acquire knowledge on how banks raise their sources and how they deploy it.
- Learn the development in banking technology.
- Study about the financial services in India.
- Acquire knowledge about the insurance Industry in India.

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM **9**

Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS/ PRODUCTS **9**

Liquid Assets - Investment in securities - Advances - Loans.Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes.Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market.

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY **9**

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money – forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT IV FINANCIAL SERVICES **9**

Introduction – Need for Financial Services – Financial Services Market in India – NBFC — Leasing and Hire Purchase — mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking.

UNIT V INSURANCE **9**

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim.

45 PERIODS

CHAIRMAN
BoS (IT)

COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the Banking system in India.
- Discuss how banks raise their sources and how they deploy it.
- Explain the development in banking technology.
- Discuss about the financial services in India.
- Explain the insurance Industry in India.

TEXT BOOKS

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.

REFERENCES:

1. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi, 2010.
2. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017.

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20M104 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Study about the introduction of blockchain technology.
- Acquire knowledge on the usage of Cryptocurrency.
- Learn about the concept of Ethereum technology.
- Study about the Web3 and Hyperledger concepts .
- Acquire knowledge about the emerging trends related to blockchain technology.

UNIT I INTRODUCTION TO BLOCKCHAIN **9**

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY **9**

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain

UNIT III ETHEREUM **9**

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV WEB3 AND HYPERLEDGER **9**

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V EMERGING TRENDS **9**

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

45 PERIODS

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COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain about the introduction of blockchain technology.
- Discuss about the usage of Cryptocurrency.
- Elaborate about the concept of Ethereum technology.
- Discuss about the Web3 and Hyperledger concepts.
- Discuss about the emerging trends related to blockchain technology.

TEXT BOOKS

1. Imran. Bashi, Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained, Packt Publishing, 2nd Edition, 2018

REFERENCES:

1. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
2. ArshdeepBahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.

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BoS (IT)

20M105 **FINTECH PERSONAL FINANCE AND PAYMENTS**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Study about the currency exchange and payment
- Acquire knowledge on the concept of digital finance and alternative finance.
- Learn about the concept of insurtech.
- Study about the process of peer to peer lending
- Acquire knowledge about the various regulatory issues related to finance.

UNIT I CURRENCY EXCHANGE AND PAYMENT **9**

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI).Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations. Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE **9**

A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity, Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH **9**

InsurTech Introduction , Business model disruption AI/ML in InsurTech, IoT and InsurTech ,Risk Modeling ,Fraud Detection Processing claims and Underwriting Innovations in Insurance Services.

UNIT IV PEER TO PEER LENDING **9**

P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology ,P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations.

UNIT V REGULATORY ISSUES **9**

FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: StartupsRegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection.

45 PERIODS

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BoS (IT)

COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain about the currency exchange and payment.
- Discuss on the concept of digital finance and alternative finance.
- Elaborate about the concept of insurtech.
- Discuss about the process of peer to peer lending.
- Explain about the various regulatory issues related to finance.

TEXT BOOKS

1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform,2016.

REFERENCES:

1. Models AuTanda, Fintech Bigtech And Banks Digitalization and Its Impact On Banking Business, Springer, 2019.
2. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016.
3. Jacob William, FinTech:TheBeginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016.
4. IIBF, Digital Banking, Taxmann Publication, 2016.
5. Jacob William, Financial Technology, Create space Independent Pub, 2016.
6. Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016.

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BoS (IT)

20M106 **INTRODUCTION TO FINTECH**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn about history, importance and evolution of Fintech.
- Acquire the knowledge of Fintech in payment industry.
- Acquire the knowledge of Fintech in insurance industry.
- Learn the Fintech developments around the world.
- Study about the future of Fintech.

UNIT I INTRODUCTION **9**

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY **9**

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY **9**

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE **9**

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH **9**

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

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BoS (IT)

45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the students will be able to,

- Explain about history, importance and evolution of Fintech.
- Discuss about the process of Fintech in payment industry.
- Discuss about the process of Fintech in insurance industry.
- Handle the process of the various Fintech around the world.
- Discuss about the future of Fintech.

TEXT BOOKS

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015

REFERENCES:

1. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016.
2. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016.
3. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018.
4. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020.
5. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018.

CHAIRMAN
BoS (IT)

20M201 **FOUNDATIONS OF ENTREPRENEURSHIP (COMMON TO ALL BRANCHES)**

L	T	P	C
3	0	0	3

OBJECTIVES:

The Students should be made to:

- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs
- To develop and strengthen the entrepreneurial quality and environment
- To apply the principles and theories of entrepreneurship and management in Technology oriented business
- To empower the learners to run a Technology driven business efficiently and effectively
- To enhance knowledge on emerging trends in entrepreneurship

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT 9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological- Technological-Environmental-Legal aspects – Human Resources. Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP 9

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends.

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP 9

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship - Success Stories of Technopreneurs - Case Studies.

UNIT V EMERGING TRENDS IN ENTREPRENEURSHIP 9

Effective Business Management Strategies for Franchising - Sub-Contracting - Leasing-Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (MECH)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learn the basics of Entrepreneurship
- Understand the business ownership patterns and environment
- Get awareness of the Job opportunities in Industries relating to Technopreneurship
- Know various applications of technopreneurs and successful technopreneurs
- Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:

1. Khanka S S, "Entrepreneurial Development", S.Chand & Co. Ltd., New Delhi, 2021.
2. Donal F Kuratko, "Entrepreneurship Theory, Process, Practice" Cengage Learning, 11th Edition, 2019.

REFERENCES:

1. Daniel Mankani, "Technopreneurship: The successful Entrepreneur in the new Economy", Prentice Hall, 2003.
2. Edward Elgar, "Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe", Wiley Publications, 2007.
3. Lang J, "The High Tech Entrepreneur's Handbook", Ft.com, 2002.
4. David Sheff, "China Dawn: The Story of a Technology and Business Revolution", 2002.
5. Dennis Posadas, "JumpStart: A Technopreneurship Fable", Pearson Prentice Hall, 2009.
6. Frederico Gonzales and Barcelon M, "Basics of Technopreneurship: Module 1.1-1.2", President-PESO Inc; UP.

CHAIRMAN
BoS (MECH)

20M202	TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Students should be made to:

- To develop and strengthen the teams and to know the basic concepts
- To apply the principles and theories of Team Building in managing Technology oriented businesses
- To impart the Leadership skills and traits essential to become successful entrepreneurs
- To learn various leadership styles and theories for business development
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

UNIT I INTRODUCTION TO MANAGING TEAMS **9**

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS **9**

Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP **9**

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS **9**

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.

UNIT V LEADERSHIP EFFECTIVENESS **9**

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (MECH)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learn the basics of managing teams for business
- Understand the techniques for developing effective teams for business management
- Know the fundamentals of leadership for running a business
- Apply various leadership styles and theories for business development
- Acquaint with emerging trends in leadership effectiveness for entrepreneurs

TEXT BOOKS:

1. Hughes R L, Ginnett R C, and Curphy G J, "Leadership: Enhancing the Lessons of Experience", McGraw Hill Education, India, 9th Edition, 2019.
2. Katzenback J R and Smith D K, "The Wisdom of Teams: Creating the High Performance Organizations", Harvard Business Review Press, 2015.

REFERENCES:

1. Haldar U K, "Leadership and Team Building", Oxford University Press, 2010.
2. Daft R L, "The Leadership Experience", Cengage, 2015.
3. Daniel Levi, "Group Dynamics for Teams", Sage Publications, 4th Edition, 2014.
4. Dyer W G, Dyer Jr W G, and Dyer J H., "Team Building: Proven Strategies for Improving Team Performance", Jossey-Bass, 5th Edition, 2013.

CHAIRMAN
BoS(MECH)

20M203	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Students should be made to:

- Develop the creativity skills among the learners
- Impart the knowledge of creative intelligence essential for entrepreneurs
- Know the applications of innovation in entrepreneurship
- Learn the concepts of innovation and entrepreneurship
- Apply innovative business models for business

UNIT I CREATIVITY 9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities-Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE 9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities-Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION 9

Innovation: Definition- Levels of Innovation- Incremental vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system.

UNIT IV INNOVATION AND ENTREPRENEURSHIP 9

Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours-Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit.

UNIT V INNOVATIVE BUSINESS MODELS 9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

TOTAL: 45 PERIODS

CHAIRMAN
BoS (MECH)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learn the basics of creativity for developing Entrepreneurship
- Know the importance of creative intelligence for business growth
- Understand the advances through Innovation in Industries
- Apply the applications of innovation in building successful ventures
- Acquaint with developing innovative business models to run the business efficiently and effectively

TEXT BOOKS:

1. Khanka S S., "Creativity and Innovation in Entrepreneurship", Sultan Chand & Sons, 2021.
2. Pradip N Khandwalla, "Lifelong Creativity, An Unending Quest", Tata Mc Graw Hill, 2004.

REFERENCES:

1. Paul Trott, "Innovation Management and New Product Development", 4th Edition, Pearson, 2018.
2. Vinnie Jauhari and Sudanshu Bhushan, "Innovation Management", Oxford Higher Education, 2014.
3. Krishnamacharyulu C S G and Lalitha R, "Innovation Management"., Himalaya Publishing House, 2010.
4. Dale Timpe, "Creativity", Jaico Publishing House, 2nd Edition, 2003.
5. Brian Clegg, Paul Birch, "Creativity", Kogan Page Limited, 7th Edition, 2009.
6. Geoff Love and Raj Echambadi's., "Strategic Innovation: Building and Sustaining Innovative Organizations", Coursera.

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BoS (MECH)

20M204	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Students should be made to:

- Provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- Provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners
- Give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners
- Understand the strategies in product promotion and distributions
- Analyze the issues in marketing management

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT 9

Introduction - Environmental Scanning - Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT 9

Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBUTION MANAGEMENT 9

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)- Logistics Management- Introduction to Retailing and Wholesaling.

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing - E-Marketing or Online Marketing.

TOTAL: 45 PERIODS

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BoS (MECH)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Get the awareness of marketing management process
- Understand the marketing environment
- Acquaint about product and pricing strategies
- Gain Knowledge of promotion and distribution in marketing management
- Comprehend the contemporary marketing scenarios and offer solutions to marketing issues

TEXT BOOKS:

1. Sherlekar S A, "Marketing Management", Himalaya Publishing House, 2016.
2. Philip Kotler and Kevin Lane Keller, "Marketing Management", 15th Edition, Pearson, 2015.

REFERENCES:

1. Vijay Prakash Anand, "Marketing Management: An Indian Perspective", Biztantra, 2nd Edition, 2016.
2. Ramaswamy V S and Namakumari S, "Marketing Management: Global Perspective, Indian Context", Macmillan Publishers India, 5th Edition, 2015.
3. Kazmi S H H., "Marketing Management", Excel Books India, 2013.
4. Dr. Gupta C B and Dr. Rajan Nair N, "Marketing Management: Text and Cases", 17th Edition, 2016.

CHAIRMAN
BoS (MECH)

20M205	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Students should be made to:

- Introduce the basic concepts, structure and functions of human resource management for entrepreneurs
- Understand the methods and techniques followed by Human Resource Management practitioners
- Create an awareness of the roles, functions and functioning of human resource department
- Gain knowledge on training and development of employees
- Empower the learners stronger in controlling the human resources

UNIT I INTRODUCTION TO HRM **9**

Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.

UNIT II HUMAN RESOURCE PLANNING **9**

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends.

UNIT III RECRUITMENT AND SELECTION **9**

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT **9**

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices.

UNIT V CONTROLLING HUMAN RESOURCES **9**

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends.

TOTAL: 45 PERIODS

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BoS (MECH)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the Evolution of HRM and Challenges faced by HR Managers
- Learn about the HR Planning Methods and practices
- Acquaint about the Recruitment and Selection Techniques followed in Industries
- Known about the methods of Training and Employee Development
- Comprehend the techniques of controlling human resources in organisations

TEXT BOOKS:

1. Gary Dessler and Biju Varkkey, "Human Resource Management", Pearson, 14th Edition, 2015.
2. Mathis and Jackson, "Human Resource Management", Cengage Learning, 15th Edition, 2017.

REFERENCES:

1. David A Decenzo, Stephen P Robbins, and Susan L Verhulst, "Human Resource Management", Wiley, International Student Edition, 2014.
2. Wayne Mondy R, "Human Resource Management", Pearson, 2015.
3. Luis R Gomez-Mejia, David B Balkin, Robert L Cardy, "Managing Human Resource", PHI Learning, 2012.
4. John M Ivancevich, "Human Resource Management", McGraw Hill Irwin, 12th Edition, 2013.
5. Aswathappa K, Sadhna Dash, "Human Resource Management - Text and Cases", McGraw Hill, 9th Edition, 2021.
6. Uday Kumar Haldar, Juthika Sarkar, "Human Resource Management", Oxford, 2012.

CHAIRMAN
BoS (MECH)

20M206	FINANCING NEW BUSINESS VENTURES (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Students should be made to:

- Impart the knowledge essential for entrepreneurs for financing new ventures
- Develop the basics of business venture financing
- Acquaint the learners with the sources of debt and equity financing
- Know the learners with sources of equity financing
- Empower the learners towards fund raising for new ventures effectively

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE 9

Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING 9

Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Debt and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING 9

Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT IV SOURCES OF EQUITY FINANCING 9

Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowd funding- Venture Capital.

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES 9

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds - Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learn the basics of starting a new business venture
- Understand the basics of venture financing
- Know the sources of debt financing
- Understand the sources of equity financing
- Acquaint with the methods of fund raising for new business ventures

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BoS (MECH)

TEXT BOOKS:

1. Brealey and Myers., "Principles of Corporate Finance", McGraw Hill Education (India) Private Limited, 12th Edition, 2018.
2. Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", McGraw Hill Education India Pvt Ltd, New Delhi, 2019.

REFERENCES:

1. Andrew Fight., "Introduction to Project Finance". Butterworth-Heinemann, 2006.
2. Andrew Metrick and Ayako Yasuda., "Venture Capital and the Finance of Innovation", John Wiley and Sons, Inc, 2nd Edition, 2010.
3. Brad Feld and Jason Mendelson., "Venture Deals", John Wiley & Sons, Inc., 3rd Edition, 2016.
4. John May and John Simons, "Every Business Needs an Angel: Getting the Money You Need to Make Your Business Grow", Crown Business, 2001.
5. Paul Alan Gompers and Joshua Lerner, "The Money of Invention: How Venture Capital Creates New Wealth", Harvard Business Press, 2001.
6. Justin J. Camp, "Venture Capital Due Diligence: A Guide to Making Smart Investment Choices and Increasing Your Portfolio Returns", John Wiley & Sons, 2002.
7. Thomas Byers, "Technology Ventures: From Idea to Enterprise", McGraw Hill Higher Education, 2014.
8. Josh Lerner, Ann Leamon, and Felda Hardymon, "Venture Capital, Private Equity, and The Financing of Entrepreneurship", 2012.

CHAIRMAN
BoS (MECH)

20M301	PRINCIPLES OF PUBLIC ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the nature of public administration.
- Learn the different functions of administration.
- Learn the different relationships and approaches.
- Understand the Bureaucratic and ecological approaches.
- Know about the leadership approaches, communication types and decision making process

UNIT-I **9**

1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II **9**

1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III **9**

1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV **9**

1. Bureaucratic Approach: Max Weber
2. Human Relations Approach : Elton Mayo
3. Ecological Approach : Riggs

UNIT-V **9**

1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers
3. Decision Making: Decision Making - Types, Techniques and Processes.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the role of public administration.
- Represent functions of administration.
- Provide the relationships and approaches in administration
- Idea about the bureaucratic and ecological approaches.
- Implement the leadership approaches, communication types and decision making process.

REFERENCES:

1. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
2. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
3. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
4. Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

CHAIRMAN
BOS/ECE

20M302	ELEMENTS OF PUBLIC ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the nature of administration in modern society
- Learn the relationships with social science.
- Learn about the organization functions and its types.
- Understand the behavior of chief executive and its role.
- Know about the personnel administration and developing society

UNIT I **9**

Administration in Modern Society; Pubic and Private administration; Evolution of the study of Public Administration. Concept of good governance.

UNIT II **9**

Public Administration as a social science; Relationship with other Social Sciences: Political Science, Economics, Sociology, Law and Psychology. Approaches to the study of Public Administration : Classical and Human Relation

UNIT III **9**

Principles of Organisations : Hierarchy, Unity of command, Span of control, Coordination, Centralisation, Decentralisation, Authority and Responsibility; Formal and Informal Organisation.

UNIT IV **9**

Chief Executive, Line and Staff, Supervision, Delegation, Leadership, Communication, Decision making , Morale and Motivation .

UNIT V **9**

Personnel Administration : Meaning and nature of Bureaucracy; Civil Services and their role in a developing society; Classification, Recruitment, Training, Promotion, Disciplinary action, code of conduct..

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Cope up with modern society.
- Maintain a good relationship with social.
- Understand the organization functions.
- Behaves as a good chief for subordinates.
- Get a idea about chief executive and follow a good code of conduct.

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REFERENCES:

1.John Pfiffiner and Robert Presthus.: Public Administration

2. Dimock & Dimock : Public Administration

3. Terry : Principles of Management

4. John D. Millet : Management in Public Services.

5. E.N. Gladden : Essentials of Public Administration

6. M.P. Shrama : Principle & Practices of Pub. Admn.,Kitab Mahal, Allahabad . Crozior M : The Bureaucratic phenomenon (Chand)

CHAIRMAN
BOS/ECE

20M303	PUBLIC PERSONNEL ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the nature of personnel administration.
- Learn the different relationships and integrity in administration.
- Understand the recruitment process and training methods
- Understand the different services in public administration.
- Knowledge about employer employee relations

UNIT-I **9**

1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II **9**

1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III **9**

1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

UNIT-IV **9**

1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V **9**

1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Execute a perfect personnel administration.
- Idea about the different relationships and integrity in administration.
- Know the recruitment process and training methods
- Prepare for the different services in public administration.
- Maintain a good relation with employer.

REFERENCES:

1. Stahl Glean O: Public Personnel Administration
2. Parnandikar Pai V.A: Personnel System for Development Administration.
3. Bhambhiru . P: Bureaucracy and Policy in India.
4. Dwivedi O.P and Jain R.B: India's Administrative state.
5. Muttalis M.A: Union Public Service Commission.
6. Bhakara Rao .V: Employer Employee Relations in India.
7. Davar R.S. Personnel Management & Industrial Relations
8. Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013.
9. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

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BOS/ECE

20M304	ADMINISTRATIVE THEORIES (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the identity of public administration.
- Learn the different models of organization and relationships.
- Understand the organizational goal and design
- Understand the different theoris of motivation and laederships in public administration.
- Knowledge about different administrative thinkers

UNIT I **9**

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as adiscipline and Identity of Public Administration

UNIT II **9**

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory

UNIT III **9**

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV **9**

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making

UNIT V **9**

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Know the identity of public administration.
- Knowledge about the different models of organization and relationships.
- Get clear idea of the organizational goal and design
- Knowledge about the different theories of motivation and leaderships in public administration.
- Analyze the different administrative thinkers idea to implement

REFERENCES:

1. Crozior M : The Bureaucratic phenomenon (Chand)
2. Blau. P.M and Scott. W : Formal Organizations (RKP)
3. Presthus. R : The Organizational Society (MAC)
4. Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
5. Keith Davis : Organization Theory (MAC)

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BOS/ECE

20M305	INDIAN ADMINISTRATIVE SYSTEM (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the Indian administration system.
- Learn the different roles of government authorities.
- Understand the constitutional amendment Act.
- Understand the functions of Integrity and Vigilance in Indian Administration.
- Knowledge about corruption and different policies of government

UNIT I **9**

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II **9**

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III **9**

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV **9**

Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V **9**

Corruption – Ombudsman, Lok Pal & Lok Ayuktha

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Know about the Indian administration system.
- Knowledge about the different roles of government authorities.
- Know the constitutional amendment Act.
- Understand the functions of Integrity and Vigilance in Indian Administration.
- Get Awareness about corruption and different policies of government

REFERENCES:

1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

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BOS/ECE

20M306	PUBLIC POLICY ADMINISTRATION (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the public policy in administration system.
- Learn the different approaches of policies.
- Understand the stages involved in policy making process.
- Understand the role of Interest groups and political parties.
- Knowledge about public policies of government

UNIT-I **9**

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.

UNIT-II **9**

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model

UNIT-III **9**

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.

UNIT-IV **9**

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.

UNIT-V **9**

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Get aware about the public policy in administration system.
- Implement the different approaches of policies.
- Get knowledge about the stages involved in policy making process.
- Know the role of Interest groups and political parties.
- Get a knowledge about public policies of government

REFERENCES:

1. Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016.
2. Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.
3. Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4. Pradeep Saxena : Public Policy Administration and Development
5. Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers,2016.

CHAIRMAN
BOS/ECE

20M401	STATISTICS FOR MANAGEMENT	L T P C
	(COMMON TO ALL BRANCHES)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Learn the applications of distribution techniques
- Understand the sampling and estimation concepts
- Analyze Hypothesis Testing and their applications
- Know about different tests for analytics
- Provide the students to apply the correlation and regressions for estimating business

UNIT I INTRODUCTION **9**

Basic definitions and rules for probability, Bayer's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION **9**

Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETIRC TESTS **9**

Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS **9**

Chi-square tests for independence of attributes and goodness of fit, Kolmogorov-Smirnov - test for goodness of fit, Mann - Whitney U test and Kruskal Wallis test.

UNIT V CORRELATION AND REGRESSION **9**

Correlation - Rank Correlation - Regression - Estimation of Regression line - Method of Least Squares - Standard Error of estimate.

TOTAL: 45 PERIODS

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BoS (AD)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Facilitate objective solutions in distribution techniques
- Analyze and solve sampling and estimation concepts
- Apply statistical techniques for Hypothesis Testing
- Develop skill-set that is in demand in both the research and business environments
- Enable the students to apply the correlation and regressions to estimate the business

TEXT BOOKS:

1. Richard I Levin, David S Rubin, Masood H Siddiqui, Sanjay Rastogi, "Statistics for Management", Pearson Education, 8th Edition, 2017.
2. Ken Black, "Applied Business Statistics", 7th Edition, Wiley India Edition, 2012.

REFERENCES:

1. Prem S Mann, "Introductory Statistics", Wiley Publications, 9th Edition, 2015.
2. Srivastava T N and Shailaja Rego, "Statistics for Management", Tata McGraw Hill, 3rd Edition 2017.
3. David R Anderson, Dennis J Sweeney, Thomas A Williams, Jeffrey D Camm, James J Cochran, "Statistics for business and economics", 13th Edition, Thomson (South – Western) Asia, Singapore, 2016.
4. Vohra N D, "Business Statistics", Tata McGraw Hill, 2017.

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20M402	DATA MINING FOR BUSINESS INTELLIGENCE (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Know how to derive meaning form huge volume of data and information
- Understand how knowledge discovering process is used in business decision making
- Learn about predictive Analytics and their applications
- Apply the techniques of clustering and classification in Business Intelligence
- Able to use various algorithms for Machine Learning and Artificial Intelligence.

UNIT I INTRODUCTION 9

Data mining, Text mining, Web mining, Data ware house.

UNIT II DATA MINING PROCESS 9

Data mining process - KDD, CRISP-DM, SEMMA Prediction performance measures.

UNIT III PREDICTION TECHNIQUES 9

Data visualization, Time series - ARIMA, Winter Holts,

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES 9

Classification, Association, Clustering.

UNIT V MACHINE LEARNING AND AI 9

Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm Optimization

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learn to apply various data mining techniques into various areas of different domains
- Be able to interact competently on the topic of data mining for business intelligence
- Apply various prediction techniques
- Learn about clustering and classification technique
- Develop and implement machine learning algorithms

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TEXT BOOKS:

1. Ralph Kimball and Richard Merz, "The data warehouse toolkit", John Wiley, 3rd Edition, 2013.
2. Galit Shmueli, Nitin R Patel and Peter C Bruce, "Data Mining for Business Intelligence-Concepts, Techniques and Applications", Wiley, India, 2010.

REFERENCES:

1. Jaiwei Ham and Micheline Kamber, "Data Mining concepts and techniques", Kauffmann Publishers2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, "Business Intelligence", Prentice Hall, 2008.
3. Inmon W H, "Building the Data Warehouse", fourth Edition Wiley India pvt. Ltd. 2005.
4. Michel Berry and Gordon Linoff, "Mastering Data mining", John Wiley and Sons Inc, 2nd Edition, 2011.
5. Michel Berry and Gordon Linoff, "Data mining techniques for Marketing", Sales and Customer support, John Wiley, 2011.
6. Gupta G K, "Introduction to Data mining with Case Studies", Prentice hall of India, 2011
7. Giudici, "Applied Data mining – Statistical Methods for Business and Industry", John Wiley, 2009.
8. Elizabeth Vitt, Michael Luckevich Stacia Misner, "Business Intelligence", Microsoft, 2011.
9. Michalewicz Z, Schmidt M Michalewicz M and Chiriac C, "Adaptive Business Intelligence", Springer Verlag, 2007

CHAIRMAN
BoS (AD)

20M403	HUMAN RESOURCE ANALYTICS	L T P C
	(COMMON TO ALL BRANCHES)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy
- Know the different types of HR metrics and understand their respective impact and application
- Understand the impact and use of HR Analytics in Training and Development
- Understand common workforce issues and analyze for engaging the employees
- Learn about Workforce Diversity and Development Metrics

UNIT I INTRODUCTION TO HR ANALYTICS 9

People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business - HR metrics and KPIs.

UNIT II HR ANLYTICS I: RECRUITMENT 9

Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire.

UNIT III HR ANALYTICS - TRAINING AND DEVELOPMENT 9

Training & Development Metrics: Percentage of employees trained- Internally and externally trained-Training hours and cost per employee - ROI.

UNIT IV HR ANALYTICS EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index- Rotation index - Career path index.

UNIT V HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling - Churn over index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

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BoS (AD)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Learners will be conversant about HR metrics and ready to apply at work settings
- Learners will be able to resolve HR issues using people analytics
- Able to analyze using HR Analytics for Training and Development
- Develop Employee Engagement Metrics and Career Progression Metrics on their own.
- Use Workforce Diversity and Development Metrics for developing Business.

TEXT BOOKS:

1. Edwards M R., & Edwards K, "Predictive HR Analytics: Mastering the HR Metric". London: Kogan Page, 2016.
2. Dipak Kumar Bhattacharyya, "HR Analytics Understanding Theories and Applications", SAGE Publications India, 2017.

REFERENCES:

1. Jac Fitzenz, "The New HR Analytics", AMACOM, 2010.
2. "Human Resources kit for Dummies", 3rd Edition, Max Messmer, 2003.
3. Sesil J C, "Applying advanced analytics to HR management decisions: Methods for selection, developing incentives, and improving collaboration. Upper Saddle River", New Jersey: Pearson Education, 2014.
4. Pease G, & Beresford B, "Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments", Wiley, 2014.
5. Phillips J, & Phillips P P, "Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and OUTCOME", McGraw-Hill, 2014.
6. "HR Scorecard and Metrices", HBR, 2001.

CHAIRMAN
BoS (AD)

20M404	MARKETING AND SOCIAL MEDIA WEB ANALYTICS (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Learn the applications Marketing Analytics for budget and performance.
- Showcase the opportunities that exist today to leverage the power of the web and social media
- Understand the Social Media Policies and problems posed by emerging social media
- Analyze the web data using web analytics strategies.
- Familiarize with various web analytics tools such as Google Analytics, Adobe Analytics, or other similar platforms

UNIT I MARKETING ANALYTICS **9**

Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT **9**

History and Evolution of Social Media-Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages- Linking Social Media Accounts-The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS **9**

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS **9**

Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS **9**

Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

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BoS (AD)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the fundamentals and importance of marketing analytics
- Gain familiarity with popular web analytics tools and technologies used in marketing and social media, such as Google Analytics, Facebook Insights, or Twitter Analytics
- Learn about Social media policies and measurements
- Assess the effectiveness of marketing and social media campaigns by tracking and analyzing key metrics and KPIs, and make data-driven decisions
- Adapt to emerging technologies, trends, and changes in the field of web analytics and social media marketing, and stay updated with industry advancements.

TEXT BOOKS:

1. Takeshi Moriguchi, "Web Analytics Consultant Official Textbook", 7th Edition, 2016.
2. Christian Fuchs, "Social Media a critical introduction", SAGE Publications Ltd, 2014.

REFERENCES:

1. Shrivastava K M, "Social Media in Business and Governance", Sterling Publishers Private Limited, 2013.
2. Bittu Kumar, "Social Networking", V & S Publishers, 2013.
3. Avinash Kaushik, "Web Analytics An Hour a Day", Wiley Publishing, 2007.
4. Ric T Peterson, "Web Analytics Demystified", Celilo Group Media and Café Press 2004.

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BoS (AD)

20M405	OPERATION AND SUPPLY CHAIN ANALYTICS (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the role of analytics in operations and supply chain management
- Learn fundamental concepts and techniques in Warehousing Decisions
- Know the Inventory management methods and models
- Use the network models and algorithms for transportation
- Learn Multiple Criteria Decision Making (MCDM) models is to equip students with the knowledge and skills to effectively analyze complex decision problems involving multiple criteria or objectives

UNIT I INTRODUCTION **9**

Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains - Basics, transforming supply chains.

UNIT II WAREHOUSING DECISIONS **9**

P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III INVENTORY MANAGEMENT **9**

Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS **9**

Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Transportation Problems, Set covering and Set Partitioning Problems, Travelling Salesman Problem, Scheduling Algorithms.

UNIT V MCDM MODELS **9**

Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

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BoS (AD)

OUTCOMES:

On successful completion of this course, the students will be able to,

- Enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.
- Ability to learn techniques to optimize warehouse processes and improve overall operational efficiency.
- Familiar with inventory management principles within the context of warehousing
- Gain a comprehensive understanding of the fundamental principles and concepts of transportation networks, including the role of transportation in supply chain management
- Apply the various MCDM methods and techniques

TEXT BOOKS:

1. Gerhard J Plenert, "Supply Chain Optimization through Segmentation and Analytics", CRC Press, Taylor & Francis Group, 2014.
2. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, "Analytics in Operations/Supply Chain Management", I.K. International Publishing House Pvt. Ltd., 2016.

REFERENCES:

1. Nada R Sanders, "Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence", Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, "Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain", Pearson Education, 2013.
3. Anna Nagurney, Min Yu, Amir H Masoumi, Ladimer S Nagurney, "Networks Against Time: Supply Chain Analytics for Perishable Products", Springer, 2013.

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20M406	FINANCIAL ANALYTICS	L T P C
	(COMMON TO ALL BRANCHES)	3 0 0 3

OBJECTIVES:

The Student should be made to:

- Understand the principles of corporate finance and analyze financial statements
- Apply finance market analysis in real-world scenarios
- Ability to apply theoretical knowledge to practical portfolio management and investment decision-making
- Learn Technical analysis for predicting financial data using charts and fundamental
- Able to assess the risk of default and assign credit ratings or risk scores

UNIT I CORPORATE FINANCE ANALYSIS **9**

Basic corporate financial predictive modeling - Project analysis - cash flow analysis - cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II FINANCIAL MARKET ANALYSIS **9**

Estimation and prediction of risk and return (bond investment and stock investment) - Time series examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III PORTFOLIO ANALYSIS **9**

Portfolio Analysis - capital asset pricing model, Sharpe ratio, Option pricing models - binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV TECHNICAL ANALYSIS **9**

Prediction using charts and fundamentals - RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.

UNIT V CREDIT RISK ANALYSIS **9**

Credit Risk analysis - Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain a solid understanding of the fundamental principles and concepts of corporate finance, including time value of money, risk and return, capital budgeting, cost of capital, and capital structure
- Apply finance market analysis techniques to real-world scenarios through case studies, simulations, or projects
- Use portfolio analysis in real-world scenarios
- The learners should be able to perform technical analysis for decision making using excel, Python and R
- Understand the techniques can be used to reduce credit risk exposure

TEXT BOOKS:

1. Yuxing Yan, "Python for Finance", Paperback – Import, 30 Jun 2017.
2. James Ma Weiming "Mastering Python for Finance Paperback", Import, 29 Apr 2015.

REFERENCES:

1. Mark J Bennett, Dirk L Hugen, "Financial analytics with R", Cambridge University Press.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Paperback – Import, 25 Oct 2013.
3. Edward E Williams, John A Dobelman "Quantitative Financial Analytics: The Path to Investment Profits Paperback" – Import, 11 Sep 2017.

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20M501 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT

(Common to all Branches) **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Gain knowledge on sustainable development goals and practices.
- Understand the concepts involved in sustainable infrastructure planning.
- Acquire knowledge on design, construction practices and techniques in construction.
- Explore the construction materials required for sustainable construction.
- Assess various measures for sustainable maintenance of infrastructure projects.

UNIT I SUSTAINABLE DEVELOPMENT GOALS **9**

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT II SUSTAINABLE INFRASTRUCTURE PLANNING **9**

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES **9**

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location

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Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings

UNIT IV SUSTAINABLE CONSTRUCTION MATERIALS 9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies

UNIT V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS 9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance

TOTAL: 45 PERIODS

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OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the environment sustainability goals at global and Indian scenario.
- Recognize risks in development of projects and suggest mitigation measures.
- Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
- Explain Life cycle analysis and life cycle cost of sustainable construction materials.
- Explore the new technologies adopted for maintenance of infrastructure projects.

REFERENCE BOOKS:

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition, Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine.
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press, ISBN: 1852930039.
7. Munier N, "Introduction to Sustainability", Springer2005
8. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
9. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing, 2009.
10. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union; 2010.
11. Hudson, Haas, Uddin, Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation, McGraw Hill, (1997).
12. Greger Lundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.

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20M502 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the issues of sustainability in agro ecology, agro ecosystem.
- Study soil health, soil erosion, control measures and suggest the management practices to improve soil nutrition.
- Explore the techniques needed for water management which leads to efficient storage system.
- Identify types and sources of agricultural wastes and suggest the suitable technologies for its sustainable management.
- Evaluate proper techniques adopted for sustainable food production.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS **9**

Ecosystem definition - Biotic *Vs.* abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT **9**

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III WATER MANAGEMENT **9**

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

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UNIT IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Explore the knowledge about the concepts, principles and advantages of sustainable agriculture.
- Discuss the sustainable ways in managing soil health, nutrients, pests and diseases.
- Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources.
- Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas.
- Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem.

REFERENCE BOOKS:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
3. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016
4. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. &Fereres, E., Springer, 2016
5. Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021
6. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014

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20M503 **SUSTAINABLE BIO MATERIALS**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Impart knowledge on biomaterials and their properties.
- Recognize the fundamentals aspects, types of biopolymers and its applications.
- Learn about the properties of bio ceramics and bio composites.
- Discuss biomedical metals, with its types, properties and applications.
- Understand the significance of bionanomaterials and its applications.

UNIT I INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure- surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT II BIO POLYMERS 9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques– Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers – Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications.

UNIT III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al_2O_3) -Zirconia (ZrO_2)-Carbon-Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Composite (PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

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UNIT IV METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT V NANOBIOMATERIALS 9

Meatllic nanobiomaterials– Nanopolymers –Nanoceramics - Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize- nanofibres -Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics - Nanomedicines- Biochips – Biomimetics - BioNEMs -Biosensor- Bioimaging/Molecular Imaging - challenges and future perspective.

TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Impart knowledge on surface properties, adhesion and performance of biomaterials.
- Analyze an overview of polymerization techniques, reactions of various biopolymers.
- Enhance the importance and properties of different bio ceramics and bio composite materials.
- Acquire knowledge on metals as biomaterials.
- Apply nano biomaterials in biomedical and other applications.

REFERENCE BOOKS:

1. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad "Functional Bionanomaterials" springer, 2020.
2. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani "Introduction to Biomaterials Basic Theory with Engineering Applications" Cambridge University Press, 2014.
3. Donglu shi "Introduction to Biomaterials" Tsinghua University press, 2006.
4. Joon Park, R.S.Lakes "Biomaterials An Introduction" third edition, Springer 2007.
5. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh "Characterization of Biomaterials" Wood head publishing, 2013.
6. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013.
7. Leopoido Javier Rios Gonzalez. "Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process" Apple academic press, 2021.
8. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.

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20M504 **MATERIALS FOR ENERGY SUSTAINABILITY**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the challenges and demands of sustainable energy sources.
- Gain fundamental knowledge about electrochemical devices and materials.
- Classify the various types of fuel cells.
- Illustrate the novel materials and their usage in photovoltaic application.
- Identify the basic principles of various types of supercapacitors and types of nano composites used in SC electrodes.

UNIT I SUSTAINABLE ENERGY SOURCES **9**

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES **9**

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O_2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, $LiCoO_2$, $LiFePO_4$, $LiMn_2O_4$) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).

UNIT III FUEL CELLS **9**

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell –

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Fuel utilization – electrolyte membrane (proton conducting and anion conducting)– Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flowfield plate, current conductors, bipolar plates and monopolar plates).

UNIT IV PHOTOVOLTAICS 9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – $Cu(InGa)Se_2$ solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis -benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine).

UNIT V SUPERCAPACITORS 9

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Acquire knowledge about various sources of energy sustainability.
- Understand the principles of different electrochemical devices.

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- Examine the working principle of fuel cells and their applications.
- Summarize the various photovoltaic applications and the materials used.
- Gain knowledge on different types of supercapacitors and the performance of various materials.

REFERENCE BOOKS:

1. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and Venkataraman Thangadurai, J. Mater. Chem. A, 2022.
3. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
4. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
5. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.
6. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.
7. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh
8. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.

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20M505 **GREEN TECHNOLOGY**

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Acquire knowledge on green chemistry and its applications.
- Identify the types of pollution and its sources.
- Classify solvents, green reagents and study the design process of chemical and microwave methods.
- Interpret the real time analysis for prevention of pollution and to provide green engineering solutions to reduce carbon foot print.
- Infer knowledge on nano materials and green nano technology.

UNIT I PRINCIPLES OF GREEN CHEMISTRY 9

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

UNIT II POLLUTION TYPES 9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT III GREEN REAGENTS AND GREEN SYNTHESIS 9

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

UNIT IV DESIGNING GREEN PROCESSES 9

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention.

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UNIT V GREEN NANOTECHNOLOGY 9

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the principles of green engineering and technology.
- Learn different types of waste, chemical, physical and biochemical methods of waste minimization.
- Modify processes and products to make them green and safe through green synthesis and green reagents.
- Design safe products through green process to prevent pollution using green technology.
- Apply advanced green nanotechnology in green synthesis to reduce environmental impacts.

TEXT BOOKS:

1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, 1997

2. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.

3. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008

REFERENCE BOOKS:

1. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

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20M506 ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the concepts of environmental monitoring and standards.
- Study the complexity of the environmental parameters through monitoring programme.
- Analyze the organic pollutants and quality through environmental analysis and monitoring by proper methods.
- Evaluate environmental monitoring programme and risk assessment.
- Identify the automated data acquisition for process monitoring and control.

UNIT I ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction- Environmental Standards- Classification of Environmental Standards- Global Environmental Standards- Environmental Standards in India- Ambient air quality standards- water quality standard- Environmental Monitoring-Need for environmental monitoring- Concepts of environmental monitoring- Techniques of Environmental Monitoring.

UNIT II MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulphur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

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UNIT IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT **9**

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol - Process of risk assessment- hazard identification-exposure assessment- dose-response assessment - risk characterization.

UNIT V AUTOMATED DATA ACQUISITION AND PROCESSING **9**

Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control - regulatory overview.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand environmental quality standards in India.
- Analyze current environmental issues, sampling methods and monitoring techniques.
- Identify the various instrumental methods and their principles for environmental monitoring.
- Enrich the significance of environmental standards through environmental monitoring programme.
- Study types and systems of data acquisition systems and processing.

TEXTBOOKS:

1.Environmental monitoring Handbook, Frank R. Burden, 2002 by The McGraw-Hill Companies, Inc.
2.Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, 1997 by CRC Press, Inc

REFERENCE BOOKS:

1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
2.H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3.Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

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20M507 INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT

(Common to all Branches)

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made to:

- Create awareness on the energy scenario of India with respect to world.
- Understand the fundamentals of energy sources, energy efficiency and environmental standards.
- Familiarization on the concept of sustainable development goal and its benefits.
- Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development.
- Identify the suitable energy policies for sustainable development.

UNIT I ENERGY SCENARIO 9

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security

UNIT II ENERGY AND ENVIRONMENT 9

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III REMEDIAL OPTIONS 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) -Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Incomeand growth.

UNIT IV RENEWABLE ENERGY TECHNOLOGY 9

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits.

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UNIT V ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT 9

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority- National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Understand the world and Indian energy scenario.
- Analyse energy projects, its impact on environment and suggest control strategies.
- Recognise the need of sustainable development and its impact on human resource development
- Apply renewable energy technologies for sustainable development.
- Categorize energy policies and planning for sustainable development.

REFERENCE BOOKS:

1. Energy Manager Training Manual (4Volumes) available at http://www.emea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Robert Ristirer and Jack P. Kraushaar, "Energy and the environment", Willey, 2005.
3. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012
4. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
5. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press,2006.
6. M.H. Fulekar, Bhawana Pathak,R K Kale, "Environment and Sustainable Development"Springer,2016
7. https://www.niti.gov.in/verticals/energy

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20M508 ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT

(Common to all Branches)

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OBJECTIVES:

The student should be made to:

- Understand the types of energy sources, energy efficiency and environmental implications of energy utilization.
- Create awareness on energy audit and its impacts.
- Categorize the techniques adopted for performance evaluation of energy efficiency in thermal utilities.
- Familiarize on the procedures adopted for energy conservation in electrical utilities.
- Identify the concepts of attaining sustainable development and social development goals.

UNIT I ENERGY AND ENVIRONMENT 9

Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING 9

Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Energy conservation avenues in steam generation and utilization, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermo compression.

UNIT IV ENERGY CONSERVTION IN ELECTRICAL UTILITIES 9

Demand side management - Power factor improvement – Energy efficient transformers – Energy conservation avenues in Motors, HVAC, fans,, blowers, pumps, air compressors,

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illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT 9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG).Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to,

- Gain knowledge on the prevailing energy scenario.
- Familiarise on energy audits and its relevance.
- Apply the concept of energy efficiency on thermal utilities.
- Identify the energy efficient conservation techniques in various electrical utilities.
- Explore sustainable development and its impact on human resource development.

REFERENCE BOOKS:

1. Energy Manager Training Manual (4Volumes) available at http://www.emea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutorybody under Ministry of Power, Government of India.2004
2. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4thEdition,Wiley,2022
3. Eastop. T.D& Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, ISBN-0-582-03184, 1990
4. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987
5. Pratap Bhattacharyya, "Climate Change and Greenhouse Gas Emission", New IndiaPublishing Agency- Nipa,2020
6. Matthew John Franchetti , Defne Apul "Carbon Footprint Analysis: Concepts, Methods,Implementation, and Case Studies" CRC Press,2012
7. M.H. Fulekar, Bhawana Pathak, R K Kale, "Environment and Sustainable Development"Springer,2016
8. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

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