B.Tech (Biomedical Engineering)
Curriculum & Syllabus

PONDICHERRY UNIVERSITY
BACHELOR OF TECHNOLOGY PROGRAMMES
(EIGHT SEMESTERS)
REGULATIONS

1. Conditions for Admission:

(a) Candidates for admission to the first semester of the 8 semester B.Tech Degree programme should be required to have passed :

The Higher Secondary Examination of the (10+2) curriculum (Academic Stream) prescribed by the Government of Tamil Nadu or any other examination equivalent there to with minimum of 45% marks (a mere pass for OBC and SC/ST candidates) in aggregate of subjects – Mathematics, Physics and any one of the following optional subjects: Chemistry / Biotechnology/ Computer Science / Biology (Botany & Zoology) or an Examination of any University or Authority recognized by the Executive Council of the Pondicherry University as equivalent thereto.

(b) For Lateral entry in to third semester of the eight semester B.Tech programme :

The minimum qualification for admission is a pass in three year diploma or four year sandwich diploma course in engineering / technology with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in the subjects covered from 3rd to final semester or a pass in any B.Sc. course with mathematics as one of the subjects of study with a minimum of 60 % marks (50% marks for OBC and a mere pass for SC/ST candidates) in aggregate in main and ancillary subjects excluding language subjects. The list of diploma programs approved for admission for each of the degree programs is given in **Annexure A**.

2. Age Limit :

The candidate should not have completed 21 years of age as on 1st July of the academic year under consideration. For Lateral Entry admission to second year of degree programme , candidates should not have completed 24 years as on 1st July of the academic year under consideration. In the case of SC/ST candidates, the age limit is relaxable by 3 years for both the cases.

3. Duration of Programme :

The Bachelor of Technology degree programme shall extend over a period of 8 consecutive semesters spread over 4 academic years – two semesters constituting one academic year. The duration of each semester shall normally be 15 weeks excluding examinations.

4. Eligibility for the award of Degree:

No candidate shall be eligible for the award of the degree of Bachelor of Technology, unless he/she has undergone the course for a period of 8

semesters (4 academic years) / 6 semesters (3 academic years for Lateral Entry candidates) in the faculty of Engineering and has passed the prescribed examinations in all the semesters.

5. Branches of Study:

Brach I - Civil Engineering
Branch II - Mechanical Engineering
Branch III - Electronics & Communication Engineering
Branch IV - Computer Science & Engineering
Branch V - Electrical & Electronics Engineering
Branch VI - Chemical Engineering
Branch VII - Electronics & Instrumentation Engineering
Branch VIII - Information Technology
Branch IX - Instrumentation & Control Engineering
Branch X - Biomedical Engineering

or any other branches of study as and when offered. The branch allocation shall be ordinarily done at the time of admission of the candidate to the first semester.

6. Subjects of Study:

The subjects of study shall include theory and practical courses as given in the curriculum and shall be in accordance with the prescribed syllabus. The subjects of study for the first two semesters shall be common for all branches of study.

7. Examinations:

The theory and practical examinations shall comprise continuous assessment throughout the semester in all subjects as well as university examinations conducted by Pondicherry University at the end of the semester (November / December or April / May).

(a) Theory courses for which there is a written paper of 75 marks in the university examination**.**

The Internal Assessment marks of 25 has to be distributed as 10 marks each for two class tests and 5 marks for class attendance in the particular subject. The distribution of marks for attendance is as follows.

5 marks for 95% and above
4 marks for 90% and above but below 95%
3 marks for 85% and above but below 90%
2 marks for 80% and above but below 85%
1 mark for 75% and above but below 80%

In total, three tests are to be conducted and the better two are to be considered for assessment.

(b) Practical courses for which there is a university practical examination of 50 marks**:**

The internal assessment marks of 50 has to be distributed as 20 marks for the periodic practical works and records submitted thereof, 15 marks for an internal practical examination, 5 marks for an internal viva voce, and 10 marks

for class attendance in the particular subject. The distribution of marks is as given below.

10 marks for 95% and above
8 marks for 90% and above but below 95%
6 marks for 85% and above but below 90%
4 marks for 80% and above but below 85%
2 marks for 75% and above but below 80%

8. Requirement for appearing for University Examination:

A candidate shall be permitted to appear for university examinations at the end of any semester only if:

(i) He / She secures not less than 75% overall attendance arrived at by taking into account the total number of periods in all subjects put together offered by the institution for the semester under consideration.

(Candidates who secure overall attendance greater than 60% and less than 75% have to pay a condonation fee as prescribed by University along with a medical certificate obtained from a medical officer not below the rank of Asst. Director)

(ii) He / She earns a progress certificate from the Head of the institution for having satisfactorily completed the course of study in all the subjects pertaining to that semester.

(iii) His / Her conduct is found to be satisfactory as certified by the Head of the institution.

A candidate who has satisfied the requirement (i) to (iii) shall be deemed to have satisfied the course requirements for the semester.

9. Procedure for completing the course:

A candidate can join the course of study of any semester only at the time of its normal commencement and only if he/she has satisfied the course requirements for the previous semester and further has registered for the university examinations of the previous semester in all the subjects as well as all arrear subjects if any.

However, the entire course should be completed within 14 consecutive semesters (12 consecutive semesters for students admitted under lateral entry).

10. Passing Minimum :

(i) A candidate shall be declared to have passed the examination in a subject of study only if he/she secures not less than 50% of the total marks (Internal Assessment plus University examination marks) and not less than 40% of the marks in University examination.

(ii) A candidate who has been declared "Failed" in a particular subject may

reappear for that subject during the subsequent semesters and secure a pass. However, there is a provision for revaluation of failed or passed subjects provided he/she fulfills the following norms for revaluation.

(a) Applications for revaluation should be filed within 4 weeks from the date of declaration of results or 15 days from the date of receipt of marks card whichever is earlier.

(b) The candidate should have attended all the college examinations as well as university examinations.

(c) If a candidate has failed in more than two papers in the current university examination, his/her representation for revaluation will not be considered.

(d) The request for revaluation must be made in the format prescribed duly recommended by the Head of the Institution along with the revaluation fee prescribed by the University.

The internal assessment marks obtained by the candidate shall be considered only in the first attempt for theory subjects alone. For the subsequent attempts, University examination marks will be made upto the total marks. Further the University examination marks obtained in the latest attempt shall alone remain valid in total suppression of the University examination marks obtained by the candidate in earlier attempts.

11 Award of Letter Grades:

The assessment of a course will be done on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain points, will be awarded as per the range of total marks (out of 100) obtained by the candidate, as detailed below:

Range of Total Marks	Letter Grade	Grade Points
90 to 100	S	10
80 to 89	A	9
70 to 79	B	8
60 to 69	C	7
55 to 59	D	6
50 to 54	E	5
0 to 49	F	0
Incomplete	FA	

'F' denotes failure in the course. 'FA' denotes absent / detained as per clause 8.

After results are declared, grade sheets will be issued to the students. The grade sheets will contain the following details:

(a) The college in which the candidate has studied.

(b) The list of courses enrolled during the semester and the grades scored.

(c) The Grade Point Average (GPA) for the semester and The Cumulative Grade Point Average (CGPA) of all enrolled subjects from first semester onwards.

(d) GPA is the ratio of sum of the products of the number of credits (C) of courses registered and the corresponding grades points (GP) scored in those courses, taken for all the courses and sum of the number of credits of all the courses

$$GPA = \left(Sum\ of\ \ (C \times GP) / Sum\ of\ \ C \right)$$

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. FA grades are to be excluded for calculating GPA and CGPA.

The conversion of CGPA into percentage marks is as given below

$$\%\, Marks = (CGPA - 0.5) \times 10$$

12 Award of Class and Rank:

(i) A candidate who satisfies the course requirements for all semesters and who passes all the examinations prescribed for all the eight semesters (six semesters for lateral entry candidates) within a maximum period of 7 years (6 years for lateral entry candidates) reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

(ii) A candidate who qualifies for the award of the degree passing in all subjects pertaining to semesters 3 to 8 in his/her first appearance within 6 consecutive semesters (3 academic years) and in addition secures a CGPA of 8.50 and above for the semesters 3 to 8 shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION**.

(iii) A candidate who qualifies for the award of the degree by passing in all subjects relating to semesters 3 to 8 within a maximum period of eight semesters after his/her commencement of study in the third semester and in addition secures CGPA not less than 6.5 shall declared to have passed the examination in **FIRST CLASS**.

(iv) All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

(v) For the Award of University ranks and Gold Medal for each branch of study, the CGPA secured from 1st to 8th semester alone should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 8th semester in the first attempt. Rank certificates would be issued to the first ten candidates in each branch of study.

13. Provision for withdrawal :

A candidate may, for valid reasons, and on the recommendation of the Head of

the Institution be granted permission by the University to withdraw from writing the entire semester examination as one Unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire course. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded DISTINCTION whereas they are not eligible to be awarded a rank.

14. Discontinuation of Course:

If a candidate wishes to temporarily discontinue the course for valid reasons, he/she shall apply through the Head of the Institution in advance and obtain a written order from the University permitting discontinuance.A candidate after temporary discontinuance may rejoin the course only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees to the University. The total period of completion of the course reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed 7 years, including of the period of discontinuance.

15. Revision of Regulations and Curriculum:

The University may from time to time revise, amend or change the regulations of curriculum and syllabus as and when found necessary.

ANNEXURE – A

B.Tech courses in which admission is sought	Diploma courses eligible for
Civil Engineering	Civil Engineering Civil and Rural Engineering Architectural Assistantship
Mechanical Engineering	Mechanical Engineering Automobile Engineering Agricultural Engineering Mechanical and Rural Engineering Refrigeration and Air-conditioning Agricultural Engineering & Farm Equipment Technology Metallurgy Production Engineering Machine Design & Drafting Machine tool maintenance
Electrical and Electronics Engineering Electronics & Communication Engineering Electronic and Instrumentation Engineering Instrumentation and Control Engineering Bio Medical Engineering	Electrical Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Instrumentation Engineering / Technology Electronics and Communication Engg. Electronics Engineering Medical Electronics Instrumentation and Control Engineering Applied Electronics
Chemical Engineering	Chemical Engineering Chemical Technology Petrochemical Technology Petroleum Engineering Ceramic Technology
Information Technology Computer Science & Engineering	Computer Science and Engineering Computer Technology Electrical and Electronics Engineering Electronics & Communication Engineering Electronics & Instrumentation Engineering Instrumentation Engineering /

I semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
T101	Mathematics-I	3	1	0	4	25	75	100
T102	Physics	3	0	0	4	25	75	100
T103	Chemistry	3	0	0	4	25	75	100
T110	Basic Civil and Mechanical Engineering	4	0	0	4	25	75	100
T111	Engineering Mechanics	2	1	0	4	25	75	100
T112	Communicative English	3	0	0	3	25	75	100
	Practical							
P104	Physics Lab	0	0	3	2	50	50	100
P105	Chemistry Lab	0	0	3	2	50	50	100
P106	Work Shop Practice	0	0	3	2	50	50	100
	Total	18	2	9	29	300	600	900

II semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
T107	Mathematics-II	3	1	0	4	25	75	100
T108	Material Science	3	0	0	3	25	75	100
T109	Environmental Science	3	0	0	3	25	75	100
T104	Basic Electrical and Electronics Engineering	3	1	0	4	25	75	100
T105	Thermodynamics	2	1	0	4	25	75	100
T106	Computer Programming	3	0	0	3	25	75	100
	Practical							
P101	Computer Programming Lab	0	0	3	2	50	50	100
P102	Engineering graphics	2	0	3	2	50	50	100
P103	Basic Electrical and Electronics Lab	0	0	3	2	50	50	100
P107	NSS/NCC*	-	-		0		-	
	Total	19	3	12	27	300	600	900

*To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation.

III semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
MA T31	Mathematics – III	3	1	0	4	25	75	100
BM T32	Electric circuit analysis	3	1	0	4	25	75	100
BM T33	Electron devices and circuits	4	0	0	3	25	75	100
BM T34	Switching theory and logical design	3	1	0	3	25	75	100
BM T35	C++ and Data Structures	3	1	0	4	25	75	100
BM T36	Strength of Materials	4	0	0	3	25	75	100
	Practical							
BM P31	Electronic devices and circuits Lab	0	0	3	2	50	50	100
BM P32	Strength of Materials Lab	0	0	3	2	50	50	100
BM P33	C++ and Data Structures Lab	0	0	3	2	50	50	100
	Total	22	2	9	27	300	600	900

IV semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
MA T41	Mathematics – IV	3	1	0	4	25	75	100
BM T42	Electronic Circuits	4	0	0	3	25	75	100
BM T43	Human Anatomy & Physiology	4	0	0	3	25	75	100
BM T44	Electrical and Electronic Instruments	4	0	0	3	25	75	100
BM T45	Dynamics of Biofluids	3	1	0	4	25	75	100
BM T46	Medical Instrumentation I	3	1	0	4	25	75	100
	Practical							
BM P41	Simulation Lab	0	0	3	2	50	50	100
BM P42	Electronic circuits Lab	0	0	3	2	50	50	100
BM P43	Medical Instrumentation Lab	0	0	3	2	50	50	100
BM P44	Physical Education*	-	-	-	0		-	
	Total	22	2	9	27	300	600	900

* Under Pass / Fail option only and not counted for CGPA calculation.

V semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
BM T51	Control Systems Engineering	3	1	0	4	25	75	100
BM T52	Microprocessors and applications	3	1	0	4	25	75	100
BM T53	Linear Integrated Circuits	4	0	0	3	25	75	100
BM T54	Signals and systems	3	1	0	4	25	75	100
BM T55	Biomechanics	3	1	0	4	25	75	100
BM T56	Medical Instrumentation II	3	1	0	4	25	75	100
	Practical							
BM P51	Linear and digital integrated Circuits Lab	0	0	3	2	50	50	100
BM P52	Bio-Engineering and Computation Lab	0	0	3	2	50	50	100
BM P53	Microprocessors and Applications Lab	0	0	3	2	50	50	100
BM P54	General Proficiency – I	3	0	0	2	100	-	100
	Total	21	3	9	31	400	600	1000

VI semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
BM T61	Embedded systems in Medicine	4	0	0	4	25	75	100
BM T62	Principles of Diagnostic and Therapeutic equipments	4	0	0	4	25	75	100
BM T63	Medical Informatics and expert systems	4	0	0	4	25	75	100
BM T64	Digital Image Processing	3	1	0	4	25	75	100
BM T65	Biomedical Signal Processing	3	1	0	3	25	75	100
BM E66	Elective I	4	0	0	3	25	75	100
	Practical							
BM P61	Biomedical Signal Processing Lab	0	0	3	2	50	50	100
BM P62	Medical Informatics and Expert systems Lab	0	0	3	2	50	50	100
BM P63	Design Project Lab	0	0	3	2	50	50	100
BM P64	General Proficiency – II	3	0	0	2	100	-	100
	Total	23	1	9	30	400	600	1000

VII semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
BM T71	Principles of Radiological equipments	4	0	0	4	25	75	100
BM T72	Biomaterials	4	0	0	3	25	75	100
BM T73	Hospital safety and Management	4	0	0	3	25	75	100
BM E74	Elective II	4	0	0	3	25	75	100
BM E75	Elective III	4	0	0	3	25	75	100
	Practical							
BM P71	Digital Image Processing Lab	0	0	3	2	50	50	100
BM P72	Seminar	3	0	0	1	100	-	100
BM P73	Industrial visit/Training	0	0	0	1	100	-	100
BM PW7	Project Work Phase I	0	0	3	2	100	-	100
	Total	20	0	6	22	475	425	900

VIII semester

Code	Subjects	Periods			Credits	Marks		
		L	T	P		IA	UE	TM
	Theory							
BM T81	Advanced Biomedical Instrumentation	4	0	0	3	25	75	100
BM T82	Engineering Economics	4	0	0	3	25	75	100
BM T83	Bio Telemetry	4	0	0	4	25	75	100
BM E84	Elective IV	4	0	0	3	25	75	100
BM E85	Elective V	4	0	0	3	25	75	100
	Practical							
BM P81	Biomedical equipments Lab	0	0	3	2	50	50	100
BM P82	Professional Ethics Practice	-	-	-	1	100	-	100
BM P83	Comprehensive Viva-voce	0	0	0	2	50	50	100
BM PW8	Project Work Phase II	0	0	6	6	50	50	100
	Total	20	0	9	27	375	525	900

Total Credits: 220

List of electives	
Sixth Semester	
BM E61	Assist Devices
BM E62	Soft Computing Techniques
BM E63	Transportation in Living Systems
BM E64	Java programming for engineers
BM E65	Biochemistry
Seventh Semester	
BM E71	Bioinformatics
BM E72	Biological Control systems
BM E73	Hospital Engineering and Information Systems
BM E74	Anesthesia
BM E75	Virtual Instrumentation
BM E76	Communication Engineering
BM E77	Elements of Biotechnology
Eighth Semester	
BM E81	Nanotechnology in Medicine
BM E82	Modeling of Physiological Systems
BM E83	Artificial organs and Rehabilitation Engineering
BM E84	VLSI Design
BM E85	Robotics and Automation
BM E86	Tissue Engineering
BM E87	Biomedical Image Analysis

MA T31 MATHEMATICS-III
(Common to ALL Branches)

UNIT-I

LAPLACE TRANSFORM: Definitions-Laplace transform of unit impulse and step functions-Laplace transform of periodic functions-Exponential shift formula-Initial and final value theorems-Laplace transform of derivatives and integrals- convolution theorem-Inverse Laplace transform-Methods of determining inverse Laplace Transform-Solution of linear differential equations using Laplace transforms (12 hours).

UNIT – II

Function of a Complex Variable: Functions of a complex variable-continuity, Derivative and analytic function-Cauchy-Riemann equations-Necessary and sufficient conditions for analyticity-Harmonic and orthogonal properties of real and imaginary parts-Conformal mapping-Bilinear transformations (12 hours).

UNIT – III

COMPLEX INTEGRATION: Cauchy's theorem-Cauchy's integral formula-Taylor's and Laurent series-Residue theorem-Contour integration round the unit circle and semicircular contour (12 Hours).

UNIT – IV

FOURIER SERIES: Dirichlet's conditions-Expansion of periodic functions into Fourier series-Change of interval-Half-range Fourier Series.
Complex form of Fourier series-Root mean square value-Parseval's theorem on Fourier coefficients-Harmonic analysis (12 Hours).

UNIT – V

FOURIER TRANSFORM: Fourier integral (statement only), Fourier transform, Inverse Fourier Transform, Fourier sine and cosine transforms, definitions and properties. (12 hours)

TEXT BOOK:

1. M.K. Venkataraman, Engineering Mathematics, Vol. II, National Publishing co. Madras, 2009 (For units I, II, and III).
2. M.K. Venkataraman, Engineering Mathematics, Vol. III, National Publishing co. Madras, 2009 (For units IV and V).

REFERENCE BOOKS:

1. N.P.Bali & Manish Goyal: A text book of Engineering Mathematics, Laxmi Publications, NewDelhi, 2008
2. Erwin Kreyszig: Advanced Engineering Mathematics, John-Wiley sons, NewYork, 2005.
3. B.S.Grewal : Engineering Mathematics, Khanna Publishers, New-Delhi, 2008

BM T32 ELECTRIC CIRCUIT ANALYSIS
(Common to ICE and BME branches)

UNIT 1

BASICS OF CIRCUIT ANALYSIS: Review of active and passive elements-Voltage–Current relationship for passive elements-Review of Kirchhoff's laws- network reduction techniques- series, parallel, series parallel circuits.

Review of fundamentals of ac circuits, inductance and capacitance parameters, Concept of Reactance, Impedance, Susceptance and Admittance, Steady state analysis of R, L and C (in series, parallel and series parallel combinations) with sinusoidal excitation- power factor, Real and Reactive powers, Complex and Polar forms of representation, Complex power.

Definitions – Graph – Tree, Basic cut-set and Basic Tie-set matrices for planar networks – Loop - Duality & Dual networks.

UNIT II

NETWORK THEOREMS FOR DC AND AC CIRCUITS: Review of loop and nodal methods of analysis, star-to-delta or delta-to-star transformation, Source transformation

Superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem, compensation theorem, Maximum power transfer theorem, Millman's theorem and Tellegen's theorem.

UNIT – III

COUPLED CIRCUITS, RESONANCE AND THREE PHASE CIRCUITS:

Resonance – Series and parallel resonance circuits- Concept of band width and Q factor.

Coupled Circuits: Faraday's laws of electromagnetic induction – Concept of self and mutual inductance – dot convention – coefficient of coupling- linear transformer- Ideal transformer

Three phase circuits: Phase sequence – Star and delta connection – Relation between line and phase voltages and currents in balanced systems – Analysis of balanced and Unbalanced 3 phase circuits – two watt meter method to measure power and power factor.

UNIT – IV

TRANSIENT ANALYSIS: Initial conditions in elements-Evaluating initial conditions in networks-Transient response of R-L, R-C, R-L-C circuits (Series combinations only) for impulse, step, pulse and sinusoidal excitations -Solution using differential equation approach and Laplace transform methods of solutions- Response of circuits for non-sinusoidal periodic inputs

UNIT – V

NETWORK FUNCTIONS AND PARAMETERS: Network functions: The concept of complex frequency-Transform impedance and transform circuits- driving point impedance and admittance-transfer function-poles and zeros.

Two port network parameters – Z, Y, ABCD, hybrid parameters and their relations– concept of transformed network – 2-port network parameters using transformed variables.

TEXT BOOKS:

1. P. Ramesh Babu "Circuit Analysis" Second edition, Scitech publications Pvt. Ltd, Second edition, 2009

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REFERENCE BOOKS:

1. William Hayt and Jack E. Kimmerly, “Engineering circuit analysis” McGraw Hill Company, 6th edition.
2. N.C. Jagan & C.Lakshminarayana, ‘Network Theory’ B.S Publications, 2006.
3. Kuriakose, “Circuit Theory”, PHI Learning, 2005

BM T33 ELECTRON DEVICES AND CIRCUITS
(Common to ICE and BME branches)

UNIT- I

JUNCTION DIODE CHARACTERISTICS : Review of semi conductor Physics – n and p –type semi conductors, Mass Action Law, Continuity Equation, Hall Effect, Open-circuited p-n junction, The p-n junction as a rectifier (forward bias and reverse bias), The current components in p-n diode, Law of junction, Diode equation, Energy band diagram of p-n diode, Volt-ampere characteristics of p-n diode, Temperature dependence of V-I characteristic, Transition and Diffusion capacitances, Breakdown Mechanism in Semi Conductor Diodes, Zener diode characteristics.

UNIT- II

BIPOLAR JUNCTION AND FIELD EFFECT TRANSISTORS: Construction, principle of operation, V-I characteristics, symbol, equivalent circuit, parameter calculations, applications, and specifications of BJT, FET and MOSFETS. Enhancement and Depletion mode MOSFET, Salient features of different configuration of BJT and FET- VVR operation of FFT-Comparison of BJT, JFET and MOSFET. devices.

UNIT- III

RECTIFIERS, FILTERS AND REGULATORS : Half wave rectifier, ripple factor, full wave rectifier, Harmonic components in a rectifier circuit, Inductor filter, Capacitor filter, L-section filter, π- section filter, Multiple L- section and Multiple π-section filter and comparison of various filter circuits in terms of ripple factors, clippers, clampers, voltage multipliers.

Simple circuit of a regulator using zener diode. Series and Shunt voltage regulators- Analysis and design- Protection circuits for voltage regulators.

UNIT IV

SPECIAL SEMICONDUCTOR DEVICES: Tunnel diode and characteristics- PIN diode- Varactor diode- Schottky diode- Gunn diode- Laser diode- photo conductive sensors- photo voltaic sensors- Light Emitting Diode (LED)- Liquid Crystal Display (LCD)- Charge coupled device (CCD)- Silicon Control Rectifier (SCR)- two transistor equivalent, DIAC, TRIAC, Applications of SCR, DIAC, TRIAC, Unijunction Transistor (UJT).

UNIT-V

BIASING AND STABILISATION : BJT biasing- DC equivalent model-Criteria for fixing operating point- Methods of Bias stabilization, fixed bias, emitter bias , voltage divider bias, DC bias with voltage feedback –Temperature compensation using diode biasing,thermistor and sensistor compensation-Thermal run away-Thermal stability, Biasing of JFET and MOSFET-uses of heat sink.

AMPLIFIERS: Small signal low frequency transistor amplifier circuits: h-parameter representation of a transistor, Analysis of single stage transistor amplifier using h-parameters: voltage gain, current gain, Input impedance and Output impedance. Comparison of transistor configurations in terms of A_I , R_i , A_v , R_o.

TEXT BOOK

1. J.Millman, C.C.Halkias, and Satyabratha Jit, "Electronic Devices and Circuits" Tata McGraw Hill, 2nd Ed., 2007.

REFERENCE BOOKS

1. R.L. Boylestad and Louis Nashelsky , Electronic Devices and Circuits , Pearson/Prentice Hall, 9th Edition,2006.

2. P. Ramesh Babu, "Electronic Devices and Circuits" Scitech Publications Pvt, Ltd., 2008
3. Nagrath, ""Electronic Devices and Circuits" PHI Learning, 2006

BM T34 SWITCHING THEORY AND LOGIC DESIGN
(Common to ICE and BME branches)

UNIT I

NUMBER SYSTEMS & CODES : Review of number systems: binary, octal and hexadecimal– complement representation of negative numbers-BCD, ASCII, EBCDIA weighted and self complimentary codes-Excess -3 –gray code- error detecting & error correcting codes –hamming codes-parity generation and detection.

BOOLEAN ALGEBRA AND SWITCHING FUNCTIONS : Review of logic gates-– universal gates- NAND/NOR realizations- Boolean Algebra - Basic theorems and properties - switching functions–Simplification of Boolean expression-sum of products and product of sums, Karnaugh map-Quine McClusky's method.

INTEGRATED CIRCUITS: Classification of ICs-Comparison of various logic families, standard TTL NAND Gate-Analysis& characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, IC interfacing- TTL driving CMOS & CMOS driving TTL .

UNIT II

COMBINATIONAL LOGIC DESIGN:

Design using conventional logic gates, half adder, full adder, half subtractor, full subtractor, magnitude comparator, Encoder, Decoder, Multiplexer, De-Multiplexer, MUX Realization of switching functions, Parity bit generator, Code-converters, Hazards and hazard free realizations.

Study of pin configurations of TTL- 74XX and CMOS 40XX series for the above combinational circuits, decoders & drives for LED & LCD display.

UNIT III

SEQUENTIAL CIRCUITS : Classification of sequential circuits (Synchronous, Asynchronous, Pulse mode, Level mode with examples) Basic flip-flops-truth table and excitation table, synchronous and asynchronous counter design-up-down counter, BCD counter- Design of modulo-N Ring & Shift registers-timing sequence-tracing problems-Hazard and hazard free asynchronous counters.

UNIT IV

Design of sequential circuits: basic models of sequential machines-concept of state diagram –design with state equations –simple circuit implementations.

Design of synchronous counters. Decade counter, shift registers & applications- Study of pin configurations of TTL- 74XX and CMOS 40XX series for the above sequential circuits.

UNIT V

ALGORTHMIC STATE MACHINES : Salient features of the ASM chart-Simple examples-System design using data path and control subsystems-control implementations-examples of Weighing machine and Binary multiplier.

PROGRAMMABLE LOGIC DEVICES, THRESHOLD LOGIC : Basic PLD's-ROM, PROM, PLA, PLD Realization of Switching functions using PLD's. Capabilities and limitations of Threshold gate, Synthesis of Threshold functions, Multigate Synthesis.

TEXTBOOKS:

1. Morris Mano, Digital Design –, PHI, 3rd Edition, 2006.
2. Anand Kumar, Digital Electronics, PHI, 2008

REFERENCE BOOKS:

1. Zvi Kohavi, Switching & Finite Automata theory –TMH, 2nd Edition.
2. Fletcher, An Engineering Approach To Digital Design –PHI.

BM T35 C++ AND DATA STRUCTURES
(Common to ICE and BME branches)

UNIT – I

INTRODUCTION TO DATA STRUCTURES – Abstract data types – Arrays – Static, Dynamic and Generic arrays. Strings – Fixed and variable size – static and dynamic strings.

UNIT – II

LINKED LISTS – Dynamic storage management – singly and doubly linked list – Stack – Application of stack – Fixed, variable and Generic stack – queues – queue based on Dynamic linked list – Trees – Binary Trees – Graphs – Warshall's Algorithms – Shortest paths.

UNIT – III

OBJECTS ORIENTED PROGRAMMING – objects and classes – methods, messages, encapsulation, abstraction, inheritance, polymorphism, dynamic building. Traditional approach Versus object orientation; benefits of object orientation – flexibility in software development – reusability – extensibility – maintainability.

UNIT – IV

OBJECTS AND CLASSES – specifying classes – using – C++ objects and data types – constructors and destructors – object as function arguments – structures and classes. Array fundamentals – array as class member data – array of objects. Structures – simple structure – accessing structure member – structure within structure – structure and classes – Function overloading – Inline function – Virtual function and polymorphism.

UNIT – V

OPERATOR OVERLOADING – overloading unary operator – overloading binary operator – data conversion. Inheritance – derived class and base class – derived class constructors –
public and private inheritance – level of inheritance. C++ graphics – text – mode graphics functions – graphics – mode graphics functions – colors – rectangles and lines – polygons and inheritance – text in graphics mode – Addresses and pointers, Simple file operations: streams – string I/O – character I/O.

TEXT BOOKS:

1. N.S. Kutti and P.Y. Padhye ,"Data Structures in C++" ,Prentice Hall of India Pvt., Ltd., New Delhi 2001.
2. Liberty & Keogh, "C++: An introduction to programming", Prentice Hall of India Pvt., Ltd., New Delhi 2002.

REFERENCES:

1. Bjarne Stroustrup, " The C++ Programming Lenguage", Addison Wesley by publication, New york 1994.
2. Jean – Paul Tremblay and Paul G.Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw Hill 1998.
3. E. Balagurusamy, "Object oriented Programming with C++", Tata McGraw Hill, New Delhi, 1996.

BM T36 STRENGTH OF MATERIALS

UNIT – I

Concept of mechanics of deformable bodies – Behavior of mild steel under tension – stress and strain – elastic constants and their relationships – equivalent modulus – factor of safety – Principal planes and principal stresses (two dimensional) – Mohr's circle representation.

UNIT – II

Bending moment and shear force diagrams for cantilever, simply supported and over hanging beams – Bending of beams: theory of simple bending – neutral axis – stress distribution across a section due to bending moment and shear force – thin cylindrical shells.

UNIT – III

Deflection of beams: Equation of deflection curve – slope and deflection by double integration method – Moment area method – conjugate beam method.

UNIT – IV

Torsion: Torsion of solid and hollow circular shafts – combined bending and torsion – springs: Leaf springs – closed and open coiled helical springs.

UNIT – V

Columns: Theory of columns – combined bending and direct stresses – concept of structural stability – long columns: Euler's theory of buckling load – Rankine – Gardon formula – Jhonson's formula – column with initial curvature.

TEXT BOOKS

1. Rajput, R.K, "Strength of Materials", S. Chand and Company Ltd., New Delhi, 2002.
2. Bhavikatti, S.S, "Strength of Materials", Vikas Publishing House (P) Ltd., 2002.

REFERENCE BOOKS

1. R.K., Bansal, Strength of Materials, M/s. Lakshmi Publications (P) Ltd, 2008.

BM P31 ELECTRON DEVICES AND CIRCUITS LAB
(Common to ICE and EIEbranches)

Any ten experiments

1. PN Junction diode and Zener diode
2. Rectifier with and without filters (Full wave & Half wave)
3. FET characteristics
4. Measurement of h parameters of transistor in CB, CE, CC configurations
5. CE Amplifier and CC amplifiers
6. Single stage R-C coupled Amplifier.
7. FET amplifier (Common Source)
8. Wien Bridge and RC Phase Shift Oscillators
9. Hartley and Colpitts Oscillators.
10. SCR, DIAC and TRIAC characteristics
11. Clippers and clampers
12 . RC wave shaping circuits

BM P32 STRENGTH OF MATERIALS LAB

List of Experiments:

Test on metals (Ferrous and Non Ferrous)

1 & 2. Tension test: To find yield stress, ultimate stress, percentage elongation and reduction in area of cross section, young's modulus and Barba's constant.
3. Torsion test.
1. Double shear test.
2. Hardness test: Vickers, Brinell and Rockwell.
3. Impact test: Charpy and lzod.
4. Bend test (180 degree and 90 degree).
5. Ductility test.
6. Static bend test on Timber.
7. Compression, Tension, Shear tests of Timber.
8. Tension test on Plastic.
9. Spring test.

Strength of Materials Lab:
Batch Size : 20 Carpet Area 200 sq.m.

1. Spring Testing Machine
2. Universal Testing Machine
3. Torsion Testing Machine
4. Vicker's Hardness Testing Machine
5. Impact Testing Machine
6. Hardness Testing Machine

BM P33 C++ AND DATA STRUCTURES LAB
(Common to ICE and EIE branches)

1. Programming using keywords of C++: public, Private, Protected.
2. Programming using keywords of C++: Inline, new and delete.
3. Programming examples for the following: function over loading.
4. Programming examples for the following: Operator over loading.
5. Programming using information hiding.
6. Programming using polymorphism.
7. Programming using inheritance.
8. Programming using object interface.
9. Programming to illustrate (i) String (ii) linked list.
10. Programming to illustrate (i) Stack (ii) Queues (iii) Trees.

MA T41 MATHEMATICS-IV
(Common to ICE and EIE branches)

UNIT – I

Partial differential equations: Formation by elimination of arbitrary constants and arbitrary functions – general, singular, particular and complete integrals – Lagrange's linear first order equation – higher order differential equations with constant coefficients.

UNIT – II

Solution of partial differential equation by the method of separation of variables – boundary value problems – Fourier series solutions – transverse vibration of an elastic string.

UNIT – III

Fourier series solution for one dimensional heat flow equation – Fourier series solutions for two dimensional heat flow equations under steady steady state conditions – (Cartesian and polar forms).

UNIT – IV

Applied statistics: Curve fitting method of least squares – fitting of straight lines, second degree parabolas and more general curves. Test of significance – large samples test for ratio of variances – chi – square test for goodness of fit and independence of attributes.

UNIT - V

Small samples – test for single mean, difference of means and correlations of coefficients, test for ratio of variances – chi – square test for goodness of fit and independence of attributes.

Test Books:

1. Venkataraman M.K., "Engineering Mathematics", National Publishing Co., Madras.
2. S.C. Gupta and V.K. Kapoor, "Fundamentals of mathematical statistics", Sultan Chand and sons, 1975.

References:

1. Erwin kreyszig, "Advance Engineering Mathematics", Wiley Eastern Ltd., 1985.
2. Grewal, D.C., "Higher Engineering Mathematics", Khanna Publishing Delhi 1985.
3. Narayanan.S., Manicavachagam Pillai,T.K., and Ramanaiah.C, "Advanced Mathematics for Engineering Students", Madras, 1985. C. Viswanathan Pvt., Ltd., Madras.

BM T42 ELECTRONIC CIRCUITS
(Common to ICE and EIE branches)

UNIT I

TRANSISTOR AND FET AMPLIFIERS : Review of small signal low frequency transistor amplifier circuits: simplified hybrid model of CE,CC,CB configurations. FET and MOSFET Small signal model.(C.G, C.D, C.S configurations), frequency response, gain bandwidth product- multistage amplifiers-cascade and cascode amplifers- Darlington connection. High frequency response of Transistor and FET amplifiers.

Differential amplifiers

Differential amplifiers – Common mode and differential mode analysis - DC and AC analysis.

UNIT II

FEEDBACK AMPLIFIERS AND OSCILLATORS: Concept of feedback, Classification of feedback amplifiers, General characteristics of negative feedback amplifiers, Effect of Feedback on Amplifier characteristics, feedback topologies, practical feedback circuits- the oscillator-conditions for oscillations-RC phase shift oscillator –Wien bridge oscillator, Colpitt's oscillator, Hartley oscillator, clap oscillator, frequency and amplitude stability in oscillators, crystal oscillator.

UNIT III

POWER AMPLIFIERS: Class A power amplifier, maximum value of efficiency of Class A amplifier, transformer coupled amplifier, transformer coupled audio amplifier, push pull amplifier, complimentary symmetry circuits (transformer less class B power amplifier), phase inverters, class D operation, class S operation,

UNIT IV

TUNED AMPLIFIERS : Single tuned capacitive coupled amplifier, tapped single tuned capacitance coupled amplifier, single tuned transformer coupled or inductively coupled amplifier, CE double tuned amplifier, application of tuned amplifiers. stagger Tuning, stability considerations, tuned class B and class C Amplifiers, wideband amplifiers, tuned amplifiers.

UNIT V

PULSE CIRCUITS

RC wave shaping circuits-Integrator and differentiator-switching diodes and transistors-storage time-Astable, monostable and bistable multivibrators, Schmitt trigger, voltage/current sawtooth sweeps-fixed amplitude and constant current generators-UJT saw tooth generator-Miller and bootstrap time bases-Multivibrator using negative resistance devices (UJT and tunnel diodes)

TEXT BOOKS :

1. J. Millman and C.C. Halkias, Integrated Electronics, McGraw-Hill, 1972.

2. Theodore F. Bogart Jr., J.S. Beasley and G. Rico, Electronic Devices and Circuits, Pearson Edition, 6th Edition, 2004.

REFERENCES :

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits Theory, Pearson/ Prentice Hall, 9th Edition, 2006.
2. Micro Electronic Circuits – Sedra A.S. and K.C. Smith, Oxford University Press, 5th ed.
3. Kumar and Jain, " Electronic devices and Circuits" PHI learning, 2007

BM T43 HUMAN ANATOMY & PHYSIOLOGY

UNIT I:

Structure and function of Cell & cellular components – Membrane Potential – Action Potential – Generation and Conduction. Blood Cell – Composition – Fluid and electrolytic balance - Blood Groups – Estimation of RBC, WBC and platelet.

Overview of Immune system – Immune response – models of immune response – Autoimmune diseases.

UNIT II

Cardiovascular system – Heart and vascular system – ECG – Blood Pressure – Homeostasis – Cardiac output – Coronary and Peripheral Circulation – Heart Sounds

Nervous System – Structure and functions of Neurons, Synapse, Reflex action and Receptors – Velocity of Conduction of Nerve Impulses – Nervous control of Heart.

UNIT III

Musculo Skeletal System – Muscle Tissue, Structure of Skeletal Muscle, Types of Muscle, Types of Joints, Major Muscles of Limbs and their actions.

Respiratory system - Physiological aspects of respiration - Exchange of gases – Regulation of Respiration. Disturbance of respiration function. Pulmonary function test – Artificial respiration – Cardio-pulmonary Resuscitation.

UNIT IV

Gastro Urinal system, Digestion and absorption – Movement of GI tract – Structure and function of kidneys and Nephron – Mechanism of Urine formation – Urine Reflex – Skin and Sweat Gland – Temperature regulation.

UNIT V

Optics of Eye – Retina - Photochemistry of Vision – Accommodation Neurophysiology of Vision – EOG.

Structure and functions Internal Ear - Mechanism of Hearing – Auditory pathway, Hearing Tests.

TEXT BOOKS:

1. Sujit K.Chaudhuri – Concise Medical Physilogy – New Central Book agency, 1997

REFERENCE BOOKS:

1. Arthur.C.Guyton – Textbook of Medical Physiology – Prism Book (p) Ltd. 1996.
2. CL.Ghai – A textbook of Practical physiology – 5th Ed Jaypee Medical Publishers, 2003
3. Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh – Text book of ‘Human Physiology – S.Chand & Company, 1996

BM T44 ELECTRICAL AND ELECTRONIC INSTRUMENTS
(Common to ICE AND EIE branches)

UNIT I

MEASUREMENT OF VOLTAGE, CURRENT, POWER AND ENERGY

Galvanometers – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter– Errors and compensation

Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter – Phantom loading – Induction type KWH meter – Calibration of wattmeter, energy meter.

UNIT II

POTENTIOMETERS & INSTRUMENT TRANSFORMERS

DC potentiometer – Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer – Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Magnetic measurements – Ballistic Galvanometer, Grassot flux meter – testing of ring specimen – method of reversal and step by step method – testing of bar specimen – Hopkinson's permeameter – Iron loss measurement by Lloyd Fisher square. AC test on magnetic materials.

C.T and V.T construction, theory, operation, phasor diagram, characteristics, testing, error elimination – Applications.

UNIT III

RESISTANCE AND IMPEDANCE MEASUREMENT

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge – Kelvin double bridge – Series and shunt type ohmmeter –High resistance measurement – Megger – Direct deflection methods – Price's guard-wire method – Loss of charge method – Earth resistance measurement.A.C bridges– Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge – Hey's bridge – Schering bridge – Anderson bridge –Campbell bridge to measure mutual inductance –Introduction to cable fault and eddy current measurement.

UNIT IV

SIGNAL GENERATORS AND ANALYZERS

Sine wave generator – Frequency synthesized sine wave generator – Sweep frequency generator, pulse and square wave generator – Function generator – Wave analyzer – Applications – Harmonic distortion analyzer – Spectrum analyzer – Applications – Audio Frequency generator – Noise generator.

UNIT V

CATHODE RAY OSCILLOSCOPE, RECORDERS AND DISPLAYS

General purpose oscilloscope – Screens for CRT graticules – Vertical & horizontal deflection systems – Delay line – Multiple trace – Dual beam & dual trace – Probes – Oscilloscope techniques – Special oscilloscopes – Storage oscilloscopes – Sampling oscilloscope. X-Y Plottres, magnetic tape recording , direct , FM , digital recording, – Data loggers.

Display devices : LED – LCD – Annunciators, Numerics, Alphanumerics

TEXT BOOKS

1. E.W.Golding & F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler & Co, 1994.
2 Albert D. Helfrick & William D. Cooper, 'Modern Electronic Instrumentation & Measurement Techniques', Prentice Hall of India, 2002.

REFERENCE BOOKS

1. Patranabis, "Principles of Electronic Instrumentation" - PHI, 2007
2. B.M.Oliver and J.M.Cage, 'Electronic Measurements & Instrumentation', McGraw Hill International Edition, 1975.
3. Joseph. J. Carr, 'Elements of Electronic Instrumentation & Measurements', III edition, Pearson Education, 2003.
4. A.K. Sawhney, 'Electrical & Electronic Measurements and Instrumentation', Dhanpath Rai & Co (P) Ltd, 2004.

BM T45 DYNAMICS OF BIOFLUIDS

UNIT I

Fluids and non-fluids, continuum coordinate systems, force and moments, stress at a point, rate of strain, properties of fluids, classification of fluids.

UNIT II

Different types of fluid flows, laminar and turbulent flow, transition from laminar to turbulent flow, laminar flow-annulus, laminar flow between parallel plates, measurement of viscosity.

UNIT III

Development of boundary layer, estimates of boundary layer thickness, boundary layer equation, nature of turbulence, smooth and rough surface, boundary layer separation.

UNIT IV

Friction loss in flow in a tube, velocity distribution of aortic system, waveform of pressure and velocity in aorta, wave reflections and impedance in arterial segments, blood flow in veins and blood flow in capillaries.

UNIT V

Control theory and system analysis, mechanical analysis of circulatory systems, basic concept of myocardial mechanics, index of contractibility, fluid dynamics of aortic and mitral valves.

TEXT BOOKS

1. K.L.Kumar, “Engineering fluid mechanics”, Eurasia Publishing House (P) Ltd., New Delhi, 1998. (UNITS I, II & III)
2. D.H.Bergel, “Cardiovascular fluid dynamics”- Vol. I, Academic press, London & New York, 1972. (UNITS IV, V)

BM T46 MEDICAL INSTRUMENTATION I

UNIT I

Generalized scheme of a measurement system – basic methods of measurements- Errors in measurements –types of errors- Statistical analysis of measurement data-mean – probability of errors – Gaussian distribution – probable error - limiting errors. Reliability of measurement systems – failure rate – reliability improvement, Availability, redundancy, choice of components and materials. Different types of noises in measurements and its Suppression methods.

UNIT II

Static characteristics of instruments – accuracy, precision, sensitivity, linearity, resolution, hysterisis, threshold, input impedance, loading effect – generalized mathematical model of measurement systems – dynamic characteristics – Modeling of Transducers – operational transfer function – zero, first and second order instruments – impulse, step, ramp and frequency response of the above instruments-techniques for dynamic compensation.

UNIT III

Transducers - Classification, selecting of transducers, circuit based on transduction. Temperature transducers – Displacement transducer - Pressure transducer - catheter tip transducers. Photoelectric transducers - Flow transducers - Piezoelectric transducers and their applications.

UNIT IV

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes.

UNIT V

Biosensors Chemoreceptors, hot and cold receptors, baro receptors, sensors for smell, sound, vision, osmolality and taste. Transducers for the measurement of ions and dissolved gases. Ion exchange membrane electrodes - Measurement of pH - Glass pH electrodes. Measurement of pO_2, Measurement of pCO_2. ISFET for glucose, urea.

Textbooks:

1. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2000. (UNIT I, II)
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, PHI, 2003. (UNIT III, IV)
3. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998. (UNIT V)

References:

1. R.Anandanatarajan, “Biomedical Instrumentation”, PHI Learning, 2009.
2. M. Arumugam, “Biomedical Instrumentation”, Anuradha Agencies Publishers, Vidayal Karuppar, 612 606, Kumbakonam, R.M.S: 1992

BM P41 SIMULATION LAB

1. Verification of Network Theorems
2. Transient response in R-L and R-C Network
3. Transient response in R-L-C Series & Parallel circuits
4. Determination of Impedance (Z) and Admittance(Y) parameters of two port network
5. Frequency response of LP and HP filters
6. Frequency response of BP and BR filters
7. Analysis of Series and parallel resonance
8. Analysis of Transistor biasing circuits (Fixed, Emitter and Collector base bias)
9. Analysis of Transistor Amplifier circuits
10. Design and Analysis of Feedback Amplifiers and Oscillators
11. Analysis of FET biasing and Amplifier circuits
12. Analysis of cascade amplifiers

BM P42 ELECTRONIC CIRCUITS LAB

1. Design of Feedback amplifiers.
2. Design of Power amplifiers.
3. Design of Tuned amplifiers
4. Design of Astable and Monostable multivibrators using discrete components.
5. Design of UJT relaxation oscillator
6. Study of logic gates and verification of Boolean expression
7. Design of adders and subtractors using logic gates
8. Design of Multiplexer and Demultiplexer circuits using logic gates
9. Design of encoder and decoder circuits using logic gates
10. Design of Flip flops using logic gates
11. Design of magnitude comparator using logic gates
12. Design of asynchronous counters
13. Design of synchronous counters

BM P43 MEDICAL INSTRUMENTATION LAB

1. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthovin Triangle.

2. Recording of blood pressure using sphygmomanometer & stethoscope

3. Measurements of various time intervals between each segment of ECG, Measurement of R-R interval and calculation of Heart Rate

4. Cardiac Efficiency Test

5. Mechanical Stimulation of the eye, Near point and Near response

6. Tuning Fork tests for Hearing

7. Peripheral pulse signal in different physical posture
8. EMG Signal for different stress on the muscle
9. Recording and interpretation of Heart sounds
10. Demonstration of Artificial respiration and Cardio Pulmonary Resuscitation.
11. Determination of Nerve conduction velocity

BM P 44 Physical Education

Physical Education is compulsory for all the Undergraduate students

1. The activities will include games and sports / extension lectures.
2. Two Hrs. / Week will be allocated for physical education in the third and fourth semesters. The student participation shall be for a minimum period of 45 hours in both the semesters put together.
3. These activities will be monitored by the Director of Physical Education.
4. Pass /Fail will be determined on the basis of participation, attendance, and performance. If a candidate Fails, he/she has to repeat the course in the subsequent years
5. Pass in this course is mandatory for the award of degree

BM T51 CONTROL SYSTEMS ENGINEERING
(Common to ICE and EIE)

UNIT-I

INTRODUCTION: Concepts of control systems- Open loop and closed loop control systems and their differences- Different examples of control systems- classification of control systems.

MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Differential equations- transfer function and block diagram representation of physical systems- translational and rotational mechanical systems, electrical systems-analogous systems- Block diagram reduction using algebra- Representation by signal flow graph- reduction using Mason's gain formula.

UNIT-II

TIME RESPONSE ANALYSIS: Standard test signals- impulse, step and ramp response analysis of first order and second order systems- Characteristics Equation of Feedback control systems, Transient Response of second order systems- Time domain specifications- Steady state response- Steady state errors and error constants- Effects of proportional derivative, proportional integral systems, performance indices.

UNIT-III

CONCEPTS OF STABILITY: The concept of stability, Routh stability criterion- qualitative stability and conditional stability. The root locus concept- construction of root loci- effects of adding poles and zeros to G(s)H(s) on the root loci-root contour.

UNIT-IV

FREQUENCY RESPONSE ANALYSIS: Frequency response specifications- Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode diagram- Phase margin and Gain margin- Stability Analysis from Bode plots. Polar plots, Nyquist plots and applications of Nyquist criterion to find the stability- Effects of adding poles and zeros to G(s)H(s) on the shape of the Nyquist diagrams, Constant M and N circles- Nichols Chart- Frequency Domain specifications from Nichols Chart.

UNIT-V

STATE-VARIABLE ANALYSIS: Introduction of state, state variables and state model, derivation of state models from block diagrams, Relationship between state equations and transfer functions- Characteristic equation, eigenvalues, eigenvectors, canonical forms Diagonalization- solving the time invariant state equations- State Transition Matrix. Controllability and observability.

TEXT BOOK:

1. R.Anandanatarajan, P.Ramesh Babu, "Control Systems Engineering", Second Edition, Scitech Publications, India, 2008.

REFERENCES:

1. J.Nagrath & M.Gopal, "Control System Engineering" Wiley Eastern, 2001

2. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning, Fourth Edition, 2002.

BM T52 MICROPROCESSORS AND APPLICATIONS
(Common to ICE and EIE)

UNIT-I

INTRODUCTION TO 8085: Generic-8-bit microprocessor and its architecture-8085 functional block diagram-Architecture-functions of different sections-Memory mapping-Memory interfacing-Instruction format-addressing modes-instruction set of 8085 CPU-instruction cycle-timing diagram-different machine cycles-fetch and execute operations-estimation of execution time.

UNIT-II

PROGRAMMING 8085: data transfer instructions-arithmetic operations-logic and branch operations-writing assembly language programmes-looping, count indexing-16 bit arithmetic instructions-arithmetic operations related to memory-logical operations, rotate compare, counter and time delays-debugging techniques. Stack- subroutine- call and return instructions-parameter passing techniques-nested subroutine. Parallel input-output and interfacing applications-peripheral and memory mapped I/O

UNIT-III

INTERFACING DEVICES: 8255 programmable peripheral interface-8253 programmable interval timer-8085 interrupts-Restart as software instructions-8259 programmable interrupt controller-direct memory access(DMA) and 8257 DMA controller-8155 and 8255 multipurpose programmable devices-8279 programmable keyboard display interface-serial I/O and data communication-8251 USART-Interfacing data converters ADC and DAC.

UNIT-IV

INTRODUCTION TO 8086: Architecture of 8086 Microprocessor- Special functions of General purpose registers- 8086 flag register and function of 8086 flags- Addressing modes of 8086- Instruction set of 8086-, Assembly language programs involving logical, Branch & Call instructions, sorting, evaluation of arithmetic expressions, string manipulation- Pin diagram of 8086-Minimum mode and maximum mode of operation- Timing diagram-Memory interfacing to 8086 (Static RAM & EPROM).

UNIT-V

APPLICATIONS OF MICROPROCESSORS: Typical application of microprocessors: stepper motor control, temperature control, thermocouple linearization, frequency measurement., phase angle and power factor measurement, Measurement of voltage, current, resistance and power, Measurement of strain, deflection and water level,measurement, Microprocessor based traffic control .

TEXT BOOKS

1. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and application with 8085", 4th Edition, Penram International Publishing, New Delhi, 2000.
(Unit I, II)

2. A.K. Ray and K.M.Burchandi, “Intel Microprocessors Architecture Programming and Interfacing”, McGraw Hill International Edition, 2000

REFERENCE BOOKS

1 John Uffenbeck, “The 80x86 Family, Design, Programming and Interfacing”, Third Edition, Pearson Education, 2002.

2. B. Ram, “Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001

3 Mohammed Ali Mazidi and Janice Gillispie Mazidi, “The 8051 Microcontroller and Embedded System”, Pearson Education Asia, New Delhi, 2006.

BM T53 LINEAR INTEGRATED CIRCUITS
(Common to ICE and BME branches)

UNIT I

INTEGRATED CIRCUITS : Classification, chip size and circuit complexity, Fundamentals of Monolithic IC technology, basic planar processes, Fabrication of a typical circuit, Active and passive components of ICs, fabrication of FET, Thin and thick film technology.

OPERATION AMPLIFIER: basic information of Op-amp, ideal and practical Op-amp, Op-amp characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential mode.

UNIT II

OP-AMP APPLICATIONS : Basic application of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, Precision rectifiers, log and antilog amplifiers, sample & hold circuits, multipliers and dividers, Differentiators and Integrators, Comparators, Schmitt trigger, Multivibrator, Triangular wave generator.

UNIT III

ACTIVE FILTERS, OSCILLATORS AND REGULATORS: Introduction-Low pass and High pass filters- Design of first and second order Butterworth lowpass and high pass filters Band pass, Band reject and all pass filters- Oscillator types and principle of operation – RC, Wien bridge oscillators triangular, saw-tooth, square wave and VCO- Introduction to voltage regulators, features of 723, Three Terminal IC regulators- DC to DC Converter- Switching Regulators-UPS-SMPS.

UNIT IV

TIMERS & PHASE LOCKED LOOPS : Introduction to 555 timer, functional diagram, monostable and astable operations and applications, Schmitt Trigger. PLL - introduction, block schematic, principles and description of individual blocks of 565-PLL applications, Analog and digital phase detectors.

UNIT V

D-A AND A- D CONVERTERS : Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, Different types of ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC, dual slope ADC and Sigma delta ADC. DAC and ADC specifications. DAC 0800 and ADC 0804 pin diagram and applications

TEXT BOOK :

1 D. Roy Chowdhury, "Linear Integrated Circuits" New Age International (p) Ltd, 2nd Ed., 2003.

REFERENCES :

1. R.F. Coughlin & Fredrick F. Driscoll. Operational Amplifiers & Linear Integrated Circuits, PHI, 6th Edition, 2003
2. Ramakanth A. Gayakwad, Op-Amps & Linear ICs –PHI, 4th Edition 2004.

BM T54 SIGNALS AND SYSTEMS

UNIT I

Elementary Continuous time signals (CT signals), Step, Ramp, Pulse, Impulse, Exponential - Elementary Discrete time signals (DT signals)- Step, Ramp, Pulse, Impulse, Exponential, - representation of discrete-time signals-basic operation on signals-classification of signals-classification of systems, CT systems and DT systems, linear and nonlinear, time-variant and time in variant systems, static and dynamic systems, causal and non-causal systems, static and dynamic systems.

UNIT -II

Representation of Fourier series, Continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum

Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function.

UNIT III

Natural response-Forced response- total response-Impulse response- convolution integral, Impulse response of interconnected systems- causality- stability- step response-correlation

Review of Laplace transforms- Partial fraction expansion- Inverse Laplace transform-Concept of region of convergence (ROC) for Laplace transforms- constraints on ROC for various classes of signals- Properties of Laplace transforms -relation between Laplace transform and Fourier transform-Laplace transform of certain signals using waveform synthesis-Computation of impulse response and transfer function using Laplace transform.

UNIT IV

Sampling theorem – Graphical and analytical proof for Band Limited Signals, effect of under sampling – Aliasing.

Fundamental difference between continuous and discrete time signals, discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, discrete-time Fourier transform and its properties, Discrete Fourier Transform Concept of Z- Transform of a discrete sequence. Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms. Computation of impulse response and transfer function using z-transform.

UNIT V

Random signal-characterization of random signal-stationary and nonstationary random signal – Ergodic and nonergodic- Ergodicity in the mean –Ergodicity in the autocorrelation-relationship Between two random signals-properties of autocorrelation and cross correlation functions-power spectral density-cross spectral density -white noise -spectral density and the

Complex frequency plane- LTI system with random input signals- The mean square value- Cross correlation between input and output- autocorrelation between input and output- Spectral density at the system output- Cross correlation density between input and output.

TEXT BOOK

1. P.Ramesh Babu & R.Ananda Natrajan, Signals and Systems, Third edition, Scitech Publications (India) Pvt. Ltd.,2007

REFERENCE BOOKS

1. Allan V.Oppenheim, “Signals and systems”, Prentice Hall of India
2. Robert A.Gael and Richard A Roberts, “Signals and Linear systems”, John Wiley and sons.
3. Roger E.Ziemer, “Signals and Systems Continuous and discrete”, McMillan.

BM T55 BIOMECHANICS

UNIT I

Use of statics, kinetics – rigid and non rigid bodies – Forces and motion – Newtons laws – Moment of force – Static equillibrum – Centre of gravity – Stability of equilibrium - Steps in analyzing a biomechanical problem – Graphical methods – contact forces – resolution of forces.

UNIT II

Bone structure & composition mechanical properties of bone, cortical and cancellous bones - Electrical properties of bone, fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons.

UNIT III

Skeletal joints, skeletal muscles, basic considerations, basic assumption and limitations, forces and stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot. Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis.

UNIT IV

Alveoli mechanics, interaction of blood and lung, P-V curve of lung, breathing mechanism, airway resistance, physics of lung diseases.

UNIT V

Mechanical properties of blood vessels – arteries, arterioles, capillaries, veins, physics of cardio vascular diseases, prosthetic heart valves and replacement. Fluids – density – pressure – blood pressure and gravity – buoyancy – moments of force and stability – movement in water - Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow.

TEXT BOOKS

1. Frank Bell, Principles of Mechanics and Biomechanics, Stanley Thorne (Publishers) Ltd., 1998 (UNIT I, V)
2. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications, CRC press, Taylor & Francis Group, LLC, 2008 (UNIT II, III)
3. Duane Knudson, Fundamentals of Biomechanics, Second Edition, Springer publication , 2007 (UNIT IV)

BM T56 MEDICAL INSTRUMENTATION II

UNIT I

Analytical equipments used in clinical environment - Beer-Lambert's Law in spectrometry. UV, visible and infra-red spectrophotometers. Blood cell counters- methods - Coulter Counters- automatic recognition and differential counting- audiometers – Automated Biochemical Analyzer – components – sampler control units – Sampling mechanisms – Flow injection analysis technique.

UNIT II

ECG Machines . Holter monitoring. Exercise systems. Measurement and application of average auditory evoked potential, visual evoked potential - magneto encephalogram - principles and measurements - Myoelectric control - Clinical applications of electrotherapy, short wave diathermy, ultrasonic diathermy, microwave diathermy, surgical diathermy unit, IR lamps, UV lamps.

UNIT III

X-Ray – Fluoroscopy - Computed tomography - Principles of sectional imaging - scanner configuration - data acquisition system - image formation principles - 2D image reconstruction techniques. Radio isotope imaging - Rectilinear scanners, linear scanners - SPECT - PET - Gamma Camera Radio nuclides for imaging, Emission Computed Tomography,

UNIT IV

Physics of Ultrasound – Ultrasound Instrumentation – Doppler, Magnetic Resonance Imaging - Principles of MRI – pulse sequence- image acquisition and reconstruction techniques – MRI instrumentation – Functional MRI - Application of MRI. Introduction to Fusion imaging.

UNIT V

Physiological effects of electrical currents, macroshock and microshock, preventive measures to reduce shock hazards, Leakage current, isolation of patient circuits, safety of electrically susceptible patients, radiation hazards and safety, shielding, open ground problem and earthing methods.

TEXT BOOKS:

1. R. S. Khandpur, Biomedical Instrumentation Technology and Applications, McGraw-Hill Professional, 2004 (UNIT I, II)
2. Raja Rao, C; Guha, S.K, Principles of Medical Electronics and Biomedical Instrumentation, Orient Longman Publishers (2000) (UNIT III, IV & V)

REFERENCE BOOKS:

1. R.Anandanatarajan, “Biomedical Instrumentation”, PHI Learning, 2009.
2. John G. Webster, Medical Instrumentation: Application and Design, 3rd edition, John Wiley & Sons, New York, 1998.

BM P51 LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB
(Common to ICE and EIE)

Minimum ten Experiments to be conducted : (five from each part A & B)

Part A (IC Application Lab):

1. OP AMP Applications – Adder, Subtractor, Integrator and Differentiator Circuits using IC 741.
2. Active Filter Applications – LPF, HPF (first order)
3. IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.
4. Function Generator using OP AMPs.
5. IC 555 Timer – Monostable and Astable Operation Circuit.
6. IC 565 – PLL Applications, IC 566 – VCO Applications.
7. Voltage Regulator using IC 723.
8. Three Terminal Voltage Regulators – 7805, 7809, 7912.
9. 4 bit DAC using OP AMP.

Part B

1. D Flip-Flop 7474
2. Decade counter-7490
3. shift registers-7495 7
4. 3-8 Decoder -74138
5. 4 bit Comparator-7485
6. 8 x 1 Multiplexer -74151 and 2x4 Demultiplexer-74155
7. RAM (16x4)-74189 (Read and Write operations)
8. Decoder drives for LED

BM P52 BIO-ENGINEERING AND COMPUTATION LAB

1. Measurement of strain using strain gauge for (i) Quarter bridge (ii) Half bridge (iii) Full bridge

2. Plotting characteristics of Photoelectric Transducer, Temperature Transducer, Piezo-electric Transducer, and Thermoelectric Transducer.

3. Determination of characteristics of Polarized Electrodes, Non-polarized Electrodes, Multi Point Electrodes.

4. Determination of characteristics of (i) DC Amplifier (ii) Chopper Amplifier and (iii) Instrumentation Amplifier.

5. Characteristics of Ultrasound Transducer and Phono Transducer.

6. Measurement of Hearing Threshold using Audiometer and plotting its characteristics.

7. Measurement of Skin Resistance & construction of a simple Lie detector.

8. Generation of original sequence along with operation on sequence like shifting, folding, time scaling and multiplication.

9. Generation of Periodic, Exponential, Sinusoidal, Damped sinusoidal, Step, Impulse, Ramp signals using MATLAB in both discrete and analog form

10. Evaluation of convolution integral, Fourier transform for periodic & non-periodic signals and simulation of differential equations using MATLAB

11. Cross correlation, Auto correlation & Spectral content of signals.

BM P53 MICROPROCESSORS AND APPLICATIONS LAB

1. Programming 8085 microprocessor kit
2. Programming 8086 microprocessor kit
3. Interfacing programmable interrupt controller
4. Interfacing of switches and display devices
5. Interfacing of D/A and A/D converters
6. Interface of key board and display using programmable controllers
7. Interface of programmable timer
8. Stepper motor control using microprocessor
9. Interfacing of 8251 and 8257
10. Study of MASM and DEBUG utilities

BM P54 GENERAL PROFICIENCY-I

UNIT -I :
ART OF COMMUNICATION: Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language – Effective Listening – Feedback

UNIT - II :
INTRODUCATION TO SOFT SKILLS: Attitude – Self-Confidence – Leadership Qualities – Emotional Quotient – Effective Time Management Skills – Surviving Stress – Overcoming Failure – Professional Ethics – Interpersonal Skills

UNIT – III :
WRITING: Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – Vocabulary Building – SWOT analysis

UNIT – IV :
SPEAKING PRACTICE: Dialogue – Telephone Etiquette – Public Speaking – Debate – Informal Discussions – Presentations

UNIT – V :
APTITUDE: Verbal and Numerical aptitude

REFERENCES :

1. Nicholls, Anne. Mastering Public Speaking. Jaico Publishing House,2003.
2. Aggarwal, R.S. Quantitative Aptitude. S.Chand &Co.,2004.
3. Leigh, Andrew and Michael Maynard. The Perfect Leader. Random House Business Books,1999.
4. Whetton .A.David and Kim S. Cameron. Developing Management Skills. Pearson Education, 2007.
5. K.R. Lakshminarayan. Developing Soft Skills. Scitech, 2009.
6. Sherfield M Robert. Developing Soft Skills Pearson Education, 2005.
7. Hair O' Dan, Friedrich W. Gustav and Lynda Dee Dixon. Strategic Communication in Business and the Professions. Pearson Education,2008.
8. Chaney Lilian and Jeanette Martin. Intercultural Business Communication, Fourth Edition. Pearson Education, 2008.

BM T61 EMBEDDED SYSTEMS IN MEDICINE

UNIT I

Definition and Classification – Overview of Processors and hardware units in an embedded system – Software embedded into the system – Exemplary Embedded Systems – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits - Embedded Hardware Architecture, Communication Interface Standards, Embedded System Development Process, Embedded Operating systems, Types of Embedded Operating systems.

UNIT II

Intel MCS51 Architecture – Derivatives - Special Function Registers (SFR), I/O pins, ports and circuits, Instruction set, Addressing Modes, Assembly Language Programming, Timer and Counter Programming, Serial Communication, Connection to RS 232, Interrupts Programming, External Memory interfacing , Introduction to 16 bit Microcontroller. Interfacing of 8051 with ADC, sensors, stepper motor, key board, & DAC.

UNIT III

PIC Microcontroller - Introduction, CPU architecture, registers, instruction sets addressing modes Loop timing, timers, Interrupts, Interrupt timing, I/o Expansion, I 2C Bus Operation Serial EEPROM, Analog to digital converter, UART-Baud Rate-Data Handling-Initialisation, Special Features - serial Programming-Parallel Slave Port

UNIT IV

Embedded system evolution trends. Round - Robin, robin with Interrupts, function-One-Scheduling Architecture, Algorithms. Introduction to-assembler-compiler-cross compilers and Intergrated Development Environment (IDE). Object Oriented Interfacing, Recursion, Debugging strategies, Simulators. Task and Task States, tasks and data, semaphores and shared Data Operating system Services-Message queues-Timer Function-Events-Memory Management, Interrupt Routines in an RTOS environment, basic design Using RTOS.

UNIT V

Applications: Real-Time Embedded Software Development, Sending a Message over a Serial Link, Simulation of a Process Control System, Controlling an Appliance from the RT Linux System, Embedded Database Applications, Embedded medical applications: Ophthalmology - Glaucoma screening device, Medical Imaging Acquisition User Interface, Drug delivery systems, Patient monitoring Systems.

TEXTBOOKS

1. Rajkamal, Embedded Systems Architecture, Programming and Design, TATA McGraw-Hill, First reprint Oct. 2003 (UNITS I, IV & V)
2. M A Mazidi & Mazidi, The 8051 micro controllers, Pearson Education (UNIT II)
3. TimWilmshusrst, Designing Embedded Systems with PIC, Newnes publishing , 2007 (UNIT III)

REFERENCES

1. Steve Heath, Embedded Systems Design, Second Edition-2003, Newnes,
2. David E.Simon, An Embedded Software Primer, Pearson Education Asia, First Indian Reprint 2000.

BM T62 PRINCIPLES OF DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

UNIT I

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types. EEG diagnostic interpretation, recording and analysis of EMG waveforms.

UNIT II

Heart lung machines - Need for the unit, functioning of bubble, disc type and membrane type oxygenerators, fingerpump, roller pump, electronic monitoring of functional parameter. Spirometer, Respiratory volume measurement, pnemograph, artificial respirator – IPR type, functioning, Pulse Oximetry.

UNIT III

Basic principles of Echo technique, display techniques A, B, M, D modes, Echo cardiograms, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, obstetrics and gynaecology. Principles of Dialysis – Hemodialysis.

UNIT IV

Electrical stimulators: Strength-duration curve, types of stimulators, an electrodiagnostic / therapeutic stimulator. Nerve-muscle stimulator: peripheral nerve stimulator, Ultrasonic stimulators, stimulators for pain and relief. Principles of Cryogenic technique and application, Endoscopy, Laproscopy, Thermography.

UNIT V

Patient monitoring system – ICU, post operative, ICCU, single channel telemetry, multichannel telemetry. Tranmsmission of Biosignals over telephone lines. Digital central monitoring systems for patient monitoring. Computer based arrhythmia detection system.

TEXT BOOK:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 1997. (UNIT III – Chapters 21; UNIT V – Chapters 6, 9)
2. John G. Webster, Medical Instrumentation: Application and Design, Wiley; 3 edition, August 1997 (UNITS I, II & IV)

REFERENCES:

1. Joseph J.carr and John M. Brown, “Introduction to Biomedical equipment technology”, John wiley and sons, New York, 1997.

BM T63 MEDICAL INFORMATICS & EXPERT SYSTEMS

UNIT I

Introduction to data structures: Elements, arrays, records, sets, tables etc. Singly and doubly linked data, stacks, queues, trees etc. Introduction to database, data models, Relational, distributed and other types of databases, data indexing and structuring techniques: data independence, data definition language and data manipulation language. E -R diagram with examples. Relational model, structure of Relational databases, Query language, views, Examples.

UNIT II

Relational database design: Normalisation - 1NF, 2NF and 3NF. Indexing and Hashing. Security of databases. Design example on a popular RDBMS package. Miniaturized data storage and retrieval system like CD-ROM, Magneto Optical Discs, optical juke boxes, write many read many devices and miniature magnetic tape devices. Interfacing and retrieval details.

UNIT III

Expert systems: Introduction - basic concepts - structure of expert systems - types of expert systems - knowledge engineering – methods & difficulties in knowledge acquisition – Search and real time search – constraint satisfaction – robot motion planning.
Medical data acquisition and database systems. Visual programming concepts; Visual Basic environment, tools and controls; Dynamic data exchange; VB based Medical information System

UNIT IV

Basic concepts of Multimedia; Design of Multimedia information systems; Components of virtual reality; Virtual reality applications in medicine. Medical Informatics and its levels; Design and development of educational packages on medical sciences; Integrated design concepts; Interactive multimedia, Virtual and digital libraries; Internet and its applications.

UNIT V

Decision making methods for Biomedicine – Bayesian statistics – decision analysis – Bayesian belief networks – Markov models – Markov decision Process – Applications to speech recognition, medical diagnosis. Hospital information System its design and functional characteristics; Principles and applications of Artificial Intelligence, Pattern Recognition, Neural Network and Fuzzy Logic in Medicine.

TEXT BOOKS:

1. J. Van Bemmel, Mark A. Musen, Handbook of Medical Informatics, Springer Publications (UNITS III, IV & V)
2. Date C J, " An introduction to Database Systems", Addison Wesley Publication (UNITS I, II)

REFRENCE BOOKS:

1. M F Collen, " Hospital Computer Systems"-
2. Lee, " Computers in Medicine", Mc Graw Hill
3. H Dominic Covvey et al , "Computer in the practice of, medicine", Addison Wesley

BM T64 DIGITAL IMAGE PROCESSING

UNIT I

Digital image fundamentals - Digital Image through scanner, digital camera. Concept of gray levels. Gray level to binary image conversion. Sampling and quantization. Relation ship between pixels. Imaging Geometry.

UNIT II

Image Transforms 2-D FFT , Properties. Walsh transform, Hadamard Transform, Discrete cosine Transform, Haar transform, Slant transform, Hotelling transform. Image enhancement Point processing. Histogram processing. Spatial filtering.

UNIT III

Enhancement in frequency domain, Image smoothing, Image sharpening. Colour image processing : Psedo colour image processing, full colour image processing. Image Restoration Degradation model, Algebraic approach to restoration, Inverse filtering, Least mean square filters, Constrained Least Squares Restoration, Interactive Restoration.

UNIT IV

Image segmentation Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region oriented segmentation.

UNIT V

Image compression Redundancies and their removal methods, Fidelity criteria, Image compression models, Source encoder and decoder, Error free compression, Lossy compression.

TEXT BOOK :

1. Digital Image processing – R.C. Gonzalez & R.E. Woods, Addison Wesley/ Pearson education, 2nd Education, 2002.

REFERENCES :

1. Fundamentals of Digital Image processing – A.K.Jain , PHI.
2. Digital Image processing using MAT LAB – Rafael C. Gonzalez, Richard E Woods and Steven
L. Edition, PEA, 2004.
3. Digital Image Processing – William K. Pratt, John Wilely, 3rd Edition, 2004.
4. Fundamentals of Electronic Image Processing – Weeks Jr., SPIC/IEEE Series, PHI.

BM T65 BIOMEDICAL SIGNAL PROCESSING

UNIT I

Simple signal conversion systems – conversion requirement for biomedical signals – signal conversion circuits. Discrete Fourier Transform (DFT) – Properties – circular and sectioned convolution – Filtering long duration sequences - FFT computation using DIT and DIF algorithms.

UNIT II

FIR design: Windowing techniques – Need and choice of Windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation – Warping, prewarping – Frequency transformation.

UNIT III

Adaptive filters – Principle noise canceller model – 50 Hz adaptive cancelling using a sine wave model – Maternal ECG cancellation in fetal electrocardiography – ECG cancellation in EMG recording – High frequency noise cancellation in Electro surgery. Signal averaging – Basics and limitations.

UNIT IV

EEG signal characteristics – EEG analysis - time and frequency domain methods – Parametric model – Phenomenological model – linear prediction theory – Autoregressive method.

UNIT V

ECG QRS detection Techniques – Estimation of R-R interval – Estimation of ST segment inclination – Arrhythmia analysis monitoring – Long term ECG recording – Basics of ECG data reduction techniques.

TEXT BOOKS:

1. DC Reddy, Biomedical Signal Processing – Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2005 (UNITS III,IV & V)
2. P.Ramesh Babu, “Digital Signal Processing”, Second Edition, Scitech publications, Chennai, 2003 (UNITS I & II)

REFERENCES:

1. Willis J.Tompkins, Biomedical Digital signal processing, Prentice Hall of India Pvt. Litd., 2000
2. Biomedical Signal Analysis A case study approach by Rangaraj M.Rangayyan, John Wiley publications.

BM P61 BIOMEDICAL SIGNAL PROCESSING LAB

Simulation

1. ECG & Arrhythmia signal generation
2. Spectrum analysis & Noise removal of biomedical signals
3. EMG processing using MATLAB –Rectification and Signal Averaging
4. To measure components in EEG Signal and Heart Rate Variability in ECG Signal simultaneously to understand the inter-relations amongst various physiological parameters
5. ECG data reduction algorithms
6. Down sampling & up-sampling of ECG signal.

Hardware

1. Detection of QRS component from ECG signals using analog circuits
2. Design of Notch filter for elimination of 50Hz from ECG signal
3. Isolation of bio-signal (EMG / ECG) using analog circuits.
4. Characterization of biopotential amplifier for ECG & EMG signals.
5. Measurement of heart rate using F-V converter
6. Measurement of respiration rate using Thermistor

.

BM P62 MEDICAL INFORMATICS & EXPERT SYSTEMS LAB

1. Develop a Mycin Expert System for diagnosis of pulmonary diseases and infectious blood Diseases.

2. Develop a DEC's XCON system for Radiotherapy treatment planning.

3. Develop an Expert System for Clinical Pathology Reporting

4. Develop an Expert System for Knowledge-based analysis and interpretation of serologic tests for hepatitis A, B, C and D

5. Develop a Smart doctor, an automated medical office system works as a patient goes through a typical office encounter

6. Develop a medical expert system for vital parameter measurement, storage and retrieval for 50 patients

7. Develop an expert system for coding medical data. The goal is to convert a narrative report, which is readable only to human beings, into a form that is usable by automated systems

8. Develop visual basic programs using control structures, Adding menus to forms & Creating dialog boxes with various options

9. Develop visual basic programs for MDI applications &various keyboard and mouse events

10. Develop visual basic programs with classes and objects & Data access through Data control.

BM P63 DESIGIN PROJECT LAB

1. Design, testing and calibration of 3½ Digit Digital Voltmeter using ICL 7107.
2. Design, testing and calibration of Monolithic function Generator using XR 2206.
3. Design, testing and calibration of Regulator Power supplies.
4. Design, testing and calibration of Batch counter using TTL ICs.
5. Design, testing and calibration of DAC and ADC
6. Design, testing and calibration of Electronic controllers.
7. Design, testing and calibration of Electronic stethoscopes.
8. Design, testing and calibration of Electronic Blood Pressure Meters.
9. Design, testing and calibration of Programmable Timers & Timer testers.
10. Design, testing and calibration of Digital pH meter using single glass electrode.
11. Design, testing and calibration of Digital Thermometer using AD590.
12. Design, testing and implementation of LPF, HPF, BPF, BRF and Notch filter using Universal Monolithic Dual switched capacitor Filter (MF10).

BM P64 GENERAL PROFICIENCY – II

UNIT – I :

COMPOSITION ANALYSIS: Technical and Non-Technical Passages (GRE Based) – Differences in American and British English – Analyzing Contemporary issues – Expanding Terminology

UNIT – II :

WRITING: Job Application Letter Writing – Resume Writing

UNIT – III :

ORAL SKILLS: Group Discussion – Introduction and Practice – Team Work – Negotiation Skills – Organizing and Attending Meetings – Facing Interviews

UNIT – IV :

ADAPTING TO CORPORATE LIFE: Corporate Etiquette – Grooming and Dressing

UNIT – V :

APTITUDE: Verbal and numerical aptitude

REFERENCES

1. Pushplata and Sanjay Kumar. Communicate or Collapse : A Handbook of Effective Public Speaking, Group Discussions and Interviews. Prentice-Hall, Delhi,2007.
2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude. Tata McGraw-Hill, 2003.
3. Thorpe, Edgar. Test Of Reasoning. Tata McGraw-Hill,2003.
4. Prasad,H.M. How to prepare for Group Discussion and Interview. Tata McGraw-Hill,2001.
5. Career Press Editors.101 Great Resumes. Jaico Publishing House,2003.
6. Aggarwal, R.S. A Modern Approach to Verbal & Non-Verbal Reasoning. S. Chand & Co.,2004.
7. Mishra Sunita and Muralikrishna, Communication Skills for Engineers, First Edition. Pearson Education, 2004.

BM T71 PRINCIPLES OF RADIOLOGICAL EQUIPMENTS

UNIT I

Production of X-rays – Various components of radiographic systems – Electrical circuit for X-ray unit – filament circuits and mA control- HT circuits- KV control –exposure switching and control of exposure timers- types of X-ray tubes for various medical applications. Rating charts of X-ray tubes.

UNIT II

Scattered radiation & its control in radiography – collimators – pinky grids – absorbed dose - Basics of tables & arms. Fluoroscopy systems – TV chain for fluroscopy – Properties of X - ray films &screens - Characteristics of imaging system by modulation transfer function.

UNIT III

Automatic exposure controls - Photo timers - types - limitations - performance - serial film chargers – types - radiographic considerations - film exposure time - photo timer applications - automatic brightness control system.

UNIT IV

Basic of digital angiography - Image processors for digital angiography - processor architecture – Temporal integration techniques for digital angiography- digital subtraction angiography .

UNIT V

Physical principles of radio therapy. Dosage data for clinical applications . Measurement of output and use of ISODOSE charts. Collimators and beam direction devices. Telemetry sources and acceptance calibration. Safety protocols & protection. Principles of linear accelerators for radiation therapy. Radiation therapy planning.

TEXTBOOKS

1. Chesneys' Equipment for Student Radiographers, 4th Edition, 4e, Wiley-Blackwell Publiishers, 1994

REFERENCE BOOKS

1. Carr & Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
2. R. S. Khandpur, “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill.
3. J.Webster, “Bioinstrumentation”, Wiley & Sons
4. Thayalan, Basic Radiological Physics, Jaypee Medical Publiishers, 2001
5. Lc Gupta, Abhitabh Gupta, Radiophysics and darkroom procedure, Jaypee Medical Publiishers, 2002

BM T72 BIOMATERIALS

UNIT I

Definition of biomaterials, requirements of biomaterials, classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties.

UNIT II

Metallic implant materials - Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with biometal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants, Vascular implants, Heart valve implants-Tailor made composite in medium.

UNIT III

Polymeric implant materials - Polyolefins, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetals. (Classification according to thermosets, thermoplastics and elastomers). Viscoelastic behavior: creep-recovery, stressrelaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems. Synthetic polymeric membranes and their biological applications

UNIT IV

Definition of bioceramics. Common types of bioceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement. Polymers filled with osteogenic fillers. Host tissue reactions.

UNIT V

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies, sensitization, carcinogenicity, mutagenicity and special tests. In vitro testing (Mechanical testing): tensile, compression, wears, fatigue, corrosion studies and fracture toughness. In-vivo testing (animals): biological performance of implants. Standards of implant materials.

TEXT BOOKS

1. Park, J. B. and Lakes, R. S., Biomaterials, Third edition, Springer (2007)

REFERENCE BOOKS

1. J B Park, Biomaterials - Science and Engineering, Plenum Press , 1984.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. C.P.Sharma & M.Szycher, Blood compatible materials and devices, Technomic Publishing Co. Ltd., 1991.
4. Piskin and A S Hoffmann, Polymeric Biomaterials (Eds), Martinus Nijhoff Publishers. (Dordrecht. 1986)

BM T73 HOSPITAL SAFETY AND MANAGEMENT

UNIT I

Clinical engineering program, educational responsibilities, role to be performed by them in hospital, staff structure in hospital – HIS. Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation

UNIT II

Difference between hospital and industrial organization, levels of training, steps of training, developing training program, evaluation of training, wages and salary, employee appraisal method.

UNIT III

Necessity for standardization, FDA, AERB, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.

UNIT IV

Nature and value of strategic management in hospitals - Awareness on the application of IT in Various functions of Hospital. Application of statistical tools in the areas of Health services. Introduction to support services - Disaster management, Ambulance services, Laundry services, Civil Assets etc.

UNIT V

Elements of Safety - Safety Publications and Standards Organizations - Orientation to Laboratory Safety - Types of risks in the hospitals - factors of environment - Safety showers and Eye Washes – Radiation hazards – radiation detection – safety measures – standards. Ergonomics - Flammables and Explosives – Formaldehydes - PEL Standards and Calculations - Material Safety - Organization of Safety in the hospitals.

TEXT BOOKS

1. P.E.Stanley, Handbook of hospital safety, CRC Press (UNIT V)
2. Arun Kumar, Hospital Management, Anmol Publications Pvt. Ltd., Jan 2000 , 1st.ed (UNITS I, II, III & IV)

REFERENCE BOOKS

1. William Charney, Handbook of Modern Hospital Safety, CRC press
2. Webster J.C. and Albert M.Cook, “Clinical Engineering Principle and Practice”, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1979
3. Goyal R.C., “Handbook of hospital personal management”, Prentice Hall of India, 1996

BM P71 DIGITAL IMAGE PROCESSING LAB

1. Display of an image, negative of an image (Binary and Gray Scale), bit planes of an image, Contrast stretching and histogram processing.
2. Fourier Transform, DCT (1D and 2D)
3. Implementation of KL transform
4. Implementation of Image Smoothening (3x3 mean, median filters) and Sharpening Filters (High pass, & derivative).
5. Image Compression using Huffman Coding & arithmetic coding
6. Implementation of Image Restoration Techniques (constrained and unconstrained).
7. Generation of spatial masks from frequency domain specifications
8. Implementation of Inverse and LMS filters.
9. Implementation of pattern recognition in Images
10. Implementation of Edge detection techniques.
11. Implementation of Image segmentation and extraction.

BM P72 SEMINAR

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for a total of 100 marks.

BM P73 INDUSTRIAL VISITS /TRAINING

During the course of study from 3rd to 7th semester each student is expected to undertake a minimum of four industrial visits or undertake a minimum of two weeks of industry/field training. The students are expected to submit a report, which shall be evaluated by an internal assessment committee at the end of seventh semester for 100 marks.

BM PW7 PROJECT WORK (PHASE-I)

The objective of the project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental , design or combination of these in the area of Electronics and Instrumentation Engineering. Each project

shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. The evaluation is based on continuous internal assessment by an internal assessment committee for 100 marks.

BM T81 ADVANCED BIOMEDICAL INSTRUMENTATION

UNIT I

Introductory physics of fiber optics, properties, Generation, transmission and detection of fiber optics - Fiber optics in diagnosis - Transmission of signals, light, and construction details of optical fiber, types of medical fiber optic scopes – Fiber optic sensors for temperature, pressure, liquid level, Doppler probe - Fiber optics endoscopy for various organs

Laser in biology: Optical properties of tissue, Pathology of laser reaction in skin, thermal effects, laser irradiation, Non thermal reactions of laser energy in tissue, effect of adjuvant.

UNIT II

Lasers in surgery: Surgical instrumentation of CO2, Ruby, Nd-YAG, He-Ne, Argon ion, Q-switched operations, continuous wave, Quasi – continuous, surgical applications of these lasers. Lasers in dermatology, lasers in ophthalmology, laser photocoagulations, laser in dentistry.

UNIT III

Speckle intereferometry, holography - Application Safety with biomedical Lasers. Basic principles of Multicolor lasers, plastic imaging multifibers, Intravascular pressure transducers and in vivo oximeters & Virtual reality assisted surgery planning

UNIT IV

Digital Imaging and Communications in Medicine (DICOM) – data formats – services. Picture archiving and communication system (PACS) – architecture – Integration with Hospital information system (HIS) and Radiology Information System (RIS) – Digital Radiography.

UNIT V

ESWL - Smart pacemakers - Minimally invasive robotic surgery - Drug encapsulation - Gene Therapy – Molecular scans - Real time imaging of the Coronary Arteries – Nanomaterials - Smart textiles - Electroactive fabrics and wearable biomonitoring devices – the Bionic person – Nanomotors

TEXT BOOKS:

1. Ronald W. Waynant, Lasers In Medicine, Taylor & Francis Ltd CRC Press Inc, Hardcover – 2001 (UNITS I, II)
2. Abraham Katzir, Lasers and Optical Fibers in Medicine, Academic Press, Oct-1993 (UNIT III)
3. H. K. Huang, PACS: Basic Principles and Applications (Paperback), Wiley-Liss; 1 edition November, 1998. (UNIT IV)
4. Joseph D Bronzino, The Biomedical Engineering Handbook, CRC Press, Third Edition – Volume II & III (UNIT V)

REFERENCE BOOKS

1. Robert Hoyt, Melanie Sutton, Ann Yoshihashi, Medical Informatics: Practical Guide For The Healthcare Professional 2007, (Paperback - 2007)
2. Leon Goldman, " The Biomedical laser Technology and Clinical Applications " Springer-Verlar
3. Nandini K. Jog, "Electronics in medicine and biomedical instrumentation", PHI

BM T82 ENGINEERING ECONOMICS

UNIT I

Introduction to Economics - Flow in an Economy, Law of supply and Demand, Concept of Engineering Economics – Engineering Efficiency, Economic Efficiency, Scope of Engineering Economics, Elements of costs, Marginal Cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-Even Analysis, P/V ratio, Elementary Economics Analysis – Material selection for product, Design selection for a product, Building material selection, Process Planning.

UNIT II

Value Engineering - Function, Aims, Value Engineering procedure, Interest Formulas and their Applications – Time Value of Money, Single Payment Compound Amount Factor, Single Payment Present Worth Factor, Equal Payment Series, Compound Amount Factor, Equal Payment Series Sinking Fund Factor, Equal Payment Series Present Worth Factor, Equal Payment Series Capital Recovery Factor, Uniform Gradient Series Annual Equivalent Factor, Effective Interest Rate, Examples in all the methods.

UNIT III

Methods of Comparison of Alternatives - Present Worth Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Future Worth Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Annual Equivalent Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram), Rate of Return Method, Examples in all the methods

UNIT IV

Replacement and Maintenance Analysis - Types of Maintenance, Types of Replacement Problem, Determination of Economic Life of an Asset, Replacement of an Asset with a New Asset – Capital Recovery with Return and Concept of Challenger and Defender, Simple Probabilistic Model for items which fail Completely.

UNIT V

Introduction to Depreciation, Straight Line Method of Depreciation, Declining Balance Method of Depreciation, Sum-of-the-Years-Digits Method of Depreciation, Sinking Fund Method of Depreciation/Annuity Method of Depreciation, Service Output Method of Depreciation, Evaluation of Public Alternatives- Introduction, Examples, Inflation Adjusted Decisions – Procedure to Adjust Inflation, Examples on comparison of alternatives and Determination of Economics Life of asset.

Text Books:

1. Panneerselvam. R., Engineering Economics, Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.

BM T83 BIO TELEMETRY

UNIT – I

Fundamental concepts – Significance, Principle, functional blocks of Telemetry and Telecontrol system-Methods of telemetry – Electrical, Pneumatic, Hydraulic and Optical Telemetry – State of the art-Telemetry standards.

UNIT – II

Electrical Telemetry-Current Systems – Voltage Systems – Synchro Systems – Frequency systems – Position and Pulse systems – Example of a landline telemetry system.

UNIT – III

Block diagram of a Radio Telemetry system – Transmitting and receiving techniques – AM, FM, PM, Multiplexing and demultiplexing – Transmitting and receiving techniques
– Digital coding methods – Advantages of PCM, PWM, PM, FSK – Delta modulation – coding and decoding equipment – Example of a radio telemetry system.

UNIT – IV

Optical fibers for signal transmission – Sources for fiber optic transmission – Optical detectors – trends in fiber – optic device development – Example of an optical telemetry System

UNIT – V

Use of computers in distance mode of healthcare delivery, Web technology, Satellite communication systems; hypertext, voice & image transfer protocols, Medical image scanning, Data compression and Transfer, Capturing of medical signals, Analog to digital conversion, Video conferencing, Remote sensing, Rural primary setups, Referral and Super specialty centers, Societal medico legal aspects, Networking (local, national & global).

TEXT BOOKS

1. D.Patranabis, Telemetry principles, Tata Mcgraw Hill Publishers (UNIT I, II, III, IV)
2. Marilyn J. Field, Telemedicine: A Guide to Assessing Telecommunications for Health Care, National Academic Press, 1996 (UNIT V)

REFERENCE BOOKS

1. Charles J. Amlaner (Author), David W. Macdonald (Author), A Handbook on Biotelemetry and Radio Tracking, Pergamon Press; 1st edition (January 1, 1980)

BM P81 BIOMEDICAL EQUIPMENTS LAB

1. Study on ECG heart rate monitor with alarm system
2. Study on peripheral pulse rate monitor with alarm system
3. Study on apnea monitor
4. Study on short wave / ultrasound diathermy unit
5. Study on EMG biofeedback system
6. Study on ECG simulator and servicing of ECG machine
7. Study on ECG Telemetry system
8. Study on Computerized Pulmonary Function Tests including Spirometry.
9. Study on Pacemaker & Defibrillator
10. Operation and function of all the controls of hospital X-Ray machine & serviving
11. Operation and function of all the controls of Ventilator
12. Study of Arrhythmia monitor.
13. Study of Computerized ECG / EMG / EEG systems

Equipments required for batch size of 20

Carpet Area 100 sq.m.

1. ECG heart rate monitor with alarm system - 2 Units
2. Peripheral pulse rate monitor with alarm system – 2 units
3. Apnea monitor - 2 Units
4. EMG biofeedback system - 1 unit
5. ECG simulator - 1 Unit
6. ECG telemetry unit. - 1 Unit
7. Audiometer - 1 Unit
8. External Pacemaker & DC Defibrillator – 1 Unit (with patient simulator)
9. Short-wave Diathermy ,Ultrasonic Diathermy & Surgical Diathermy Unit – each 1 Unit
10. Special storage oscilloscope with facility for automatic - 10 No’s

BM P82 PROFESSIONAL EHICS PRACTICE

The course should cover the following topics by way of Seminars, Expert Lectures and Assignments:

1. Engineering Ethics – Moral issues, Ethical theories and their uses
2. Engineering as Experimentation – Code of Ethics
3. Engineer's responsibility for safety
4. Responsibilities and rights
5. Global issues of engineering ethics

REFERENCE BOOK

1. Charles D.Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999

BM P83 COMPREHENSIVE VIVA-VOCE

The student will be tested for his understanding of the basic principles of the core engineering subjects. The internal assessment for a total of 50 marks will be made by a committee comprising of the faculty members of the department. The committee will conduct a written examination (objective type and short questions from all the core subjects) followed by a viva voce examination. The external university examination, which carries a total of 50 marks, will be a viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.

BM PW8 PROJECT WORK (PHASE II)

Extension and completion of project work started in the previous semester. On completion of the project work, each student has to prepare a project report and submit the same to the department.

In the Phase II, the project work and the report will be evaluated by the internal assessment committee for a total of 50 marks. The external university examination, which carries a total of 100 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

BM E61 ASSIST DEVICES

UNIT I

Principle of External counter pulsation techniques, intra aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT

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

UNIT III

Hearing aids - Common tests – audiograms, airconduction, boneconduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV

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

UNIT V

Electrotherapy, Transcutaneous electrical nerve stimulator, Interferential current, Galvanic stimulation, Uses, safety aspects. Deep brain stimulation. Bio-feedback - Efficacy ratings - Major modalities - Applications

TEXT BOOKS

1. Levine S.N. (ed), “Advances in Bio-medical engineering and Medical physics”, Vol. I, II, IV,inter university publications, New York, 1968 (Unit I, IV, V).
2. Kolff W.J, “Artificial Organs”, Johnwiley and sons, New York, 1976. (Unit II).
3. Albert M.Cook and Webster J.G, “Therapeutic Medical Devices”, Prentice Hall Inc., New Jersey, 1982 (Unit III).

BM E62 SOFT COMPUTING TECHNIQUES

UNIT I

Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II

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

UNIT III

Introduction to Neural Networks - Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV

Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation.

UNIT V

Applications: Pattern Recognitions, Image Processing, Biological Sequence Alignment and Drug Design, Robotics and Sensors, Information Retrieval Systems, Natural Language Processing

TEXT BOOKS

1. S.Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003. (UNIT I. III, IV, V)
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.(UNIT II)

REFERENCE BOOKS

1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
2. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
3. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.

BM E63 TRANSPORTATION IN LIVING SYSTEM

UNIT I

Introduction: Organization of the human body, cells, tissues, different organs, natural membrane system.

UNIT II

Heat transport: Body temperature regulation based on thermostate principle and its operation, transportation in tissues, muscle, skin and other organs in different environmental temperature.

UNIT III

Transportation of fluids: Blood transport trough internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, diffusion, osmosis, electroosmosis, ultrafiltration, reverse osmosis through natural membrane systems, reverse osmosis through artificial synthetic membranes.

UNIT IV

Transportation of lymph: Transportation of lymph through internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, problems on lymph transfer in human body.

UNIT V

Mass transfer: Constituents of blood, urine, mass transfer in kidney, skeletal, nervous, gastro intestine system, cardio pulmonary system, comparision with artificial organs.

TEXT BOOK:

1. Sujit K.Chaudhuri – Concise Medical Physilogy – New Central Book agency, 1997

REFERENCE BOOKS:

1. David O.Cooney, An introduction to fluid, heat & mass transport process- Principles, Vol.1, Marcel Dekker Inc., Newyork.
2. Gang, Medical Physiology
3. Best and Taylor, Physiology.

BM E64 JAVA PROGRAMMING FOR ENGINEERS

UNIT I

Introduction to Java - Basic programming - Including identifiers, variables, constants, data types, operator precedence, programming style and documentation.

UNIT II

Control Structures including selection structures and looping structures, and the use of nested structures. Methods - Including creating and calling, passing parameters, overloading, and method abstraction.

UNIT III

Programming with Objects and Classes - Including creating objects and classes, garbage collection, constructors, analyzing relationships among objects, the String class, the String Buffer class. Arrays and Vectors - Declaring and creating arrays, processing arrays, arrays of objects

UNIT IV

Inheritance - Superclasses and subclasses, overriding methods, the Object class, abstract classes, polymorphism. Graphics Programming - Introduction to Graphics Programming using containers, components, helpers, and creation of event objects.

UNIT V

Applets - Conversion of GUI applications to applets - Exception Handling - Use of try, catch, throw, and throws with text based applications, GUI applications, and applets.

TEXT BOOKS

1. Liang, Y Daniel.Introduction to Java Programming: Comprehensive Version, 6th. ed. Prentice Hall.

REFERENCES

1. Web reference: http://java.sun.com.
2. Patrick Naughton, “COMPLETE REFERENCE: JAVA2”, Tata McGraw-Hill, 2003.
3. Harvey Deitel, “Java How to Program”, Sixth Edition, Prentice Hall, NJ, 2005

BME E65 BIO CHEMISTRY

UNIT I

Biochemistry of living cell, Sub cellular fractionation using the differential centrifugation method. Function of each organelle Redox Potential, Oxidative Phosphorylation, Transport of substances across biological membrane. NUCLEIC ACID: Composition and Function, Genes, Outline of DNA Structure, Re-Combinant DNA and its applications.

UNIT II

Enzymes: Chemical Nature, General Properties, Spectrophotometric measurement of enzymes, Isolation techniques, Diagnostic enzymes. Enzyme biotechnology. Hormones: Chemical Nature, Properties of hormones, Hormonal Assay and their Significance.

UNIT III

Carbohydrate – Classification, Metabolism of carbohydrate and its dysfunction. Uses of Carbohydrates. Lipids: Classification, Metabolism of lipids, Cholesterol, bile acids, Transport of lipids, Lipid metabolism dysfunction. Protein: Classification, Amino acids, Chromatography, electrophoresis and architecture of protein molecules.

UNIT IV

Liver Function tests, Renal Function Tests, Blood gas Analysis, Measurement of Electrolytes. Their abnormal and Normal Values and Conditions. Biochemistry of Urine and Stools testing.

UNIT V

Principles and Application of Photometry, Spectrophotometry, Flurometry, Flame Photometry, Densitometry, Calorimetry, Automation in Clinical Laboratory. Use of Isotopes in Biochemistry.

TEXT BOOK

1. Dr. Ambiga Shanmugam, ‘Fundamentals of Bio Chemistry for Medical Students’, Karthic Printers, Madras 1997.

BM E71 BIO-INFORMATICS

UNIT I

Introduction to genomics: Information flow in biology, DNA sequence data, experimental approach to genome sequence data, genome information resources.

UNIT II

Functional proteomics: Protein sequence and structural data, protein information resources and secondary data bases.

UNIT III

Computation genomics: Internet basics, biological data analysis and application, sequence and data bases, NCBI model, file format, Perl programming, bioperl, introduction and overview of human genomic project.

UNIT IV

Sequence alignment and data base search: Protein primary sequence analysis, DNA sequence analysis, pair wise sequence alingnment, FASTA algorithm, BLAST, multiple sequence alignment, DATA base searching using BLAST and FASTA.

UNIT V

Structural data bases: Small molecules data bases, protein information resources, protein data bank, genebank, swissport, enterz..

TEXT BOOKS

1. Andrzej Polanski, Marek Kimmel, Bioinformatics, Springer publications, 2007

REFERENCE BOOKS

1. Introduction to bioinformatics, Atwood, Pearson education.
2. Introduction to bioinformatics, Arther M.Lesk-OUP
3. Bioinformatics sequences and genome analysis, David W.Mount, 2nd. Edn. CBS publishers.
4. Introduction to bioinformatics computer skills, Cynthia Gibas and Per Jambeck, 2001 SPD.

BM E72 BIOLOGICAL CONTROL SYSTEMS

UNIT I

Introduction: Technological control system, transfer function, mathematical approaches, system stability, introduction to biological control system, Modeling and block diagram, closed loop dynamics of first order and second order control system, similarities between biological and engineering control system, biological receptors and receptor characteristics.

UNIT II

Process regulation: Acid-base balance, extra-cellular water and electrolyte, interstitial fluid volume, blood pressure, blood glucose, CO2.

UNIT III

Modeling of human thermal regulatory system: Parameters involved, control system model etc. Biochemistry of digestion, types of heat loss from body, models of heat transfer between subsystems of human body like skin - core etc. and systems like within body, body environment.

UNIT IV

Biological control I: Cardiac rate, blood pressure, respiratory rate, mass balancing of lungs, oxygen uptake by RBC and pulmonary capillaries, oxygen and carbon dioxide transport in blood and tissues.

UNIT V

Biological control II: Urine formation and control, Pupil control systems, skeletal muscle servomechanism, and semicircular canal. Free swinging limbs, Endocrine control system.

TEXT BOOKS

1. Sujit K.Chaudhuri – Concise Medical Physilogy – New Central Book agency, 1997 (UNITS II, III, IV & V)
2. Modern control engineering. Ogata Katsuhika. 2nd edition, Prentice Hall of India (UNIT I)

REFERENCE BOOKS:

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1. Barry R. Dworkin, Learning and Physiological Regulation (Hardcover), University Of Chicago Press, March 1993.
2. E. Carson, E. Salzsieder, Modelling and Control in Biomedical Systems 2000 (including Biological Systems) (IFAC Proceedings Volumes) (Paperback), Pergamon Publishing, January 2001.

BM E73 HOSPITAL ENGINEERING & INFORMATION SYSTEMS

UNIT I

Classification of hospital & architecture: General hospital, specialized hospital, primary health care – their role and functions. Aspects of hospital services – inpatient, outpatient and emergency. Location and environment of hospital, Hierarchy of medical and paramedical staff & their functions and responsibilities. Modern Hospital Architecture- space in a hospital building, design of ward, intensive care units, air conditioning, plumbing & sanitation, gas supply, waste disposal,
cleaning, dietry, sterilizing, laundry, storage and operation theatre systems, Radiology, Central labs, Blood banks, OPD, Casuality, etc.

UNIT II

Electrical power systems in hospitals: Safety of electrical systems, Protective systems - interference of patient's protection grounding. Design of sub stations, breakers, Surge protectors, EMI filters, voltage stabilizers, generator sets and UPS. Uninterrupted power supply for ICU and computerized monitoring units. Specification & estimation for hospital wiring - small case study.

UNIT III

Air conditioning & gas supply systems: Air conditioning and refrigeration systems for small and large areas. Air changes, filtering and sterility. Deodourization, disinfection, dehumidification and cryogenic systems. Centralized supply of air, oxygen, nitrous oxide & vacuum - Principle of production of liquid oxygen. Management lifts fire fighting equipments.

UNIT IV

Hospital engineering & Management: Definition of biomedical Engineering, clinical engineering & hospital engineering. Importance of BME department – servicing and maintenance, testing, acceptance & maintenance protocols, Computerized preventive maintenance planning, MROs. Training of men for medical equipments preventive and periodical maintenance procedures. Preparation of estimates, specifications, tender details etc. Importance of ISO 9000 Certificates - Obtaining ISO certificates in hospitals. Proposed protocols.

UNIT V

Hospital Information system: Role of database in HIS. Need of Networking in HIS. Overview of Networking, topologies and its configuration. Structuring medical records to carry out functions like admissions, discharges, treatment history etc. Computerization in pharmacy & billing. Automated clinical laboratory systems & radiology information system.

TEXT BOOK

1. Harold E. Smalley, "Hospital Management Engineering – A guide to the improvement of hospital management system", PHI.

REFERENCE BOOKS:

1. Sharma, Essentials for Hospital Support Services and Physical Infrastructure, 1/e, Jaypee Medical Publishers 2003
2. Hospital Engineering And Facilities Management 2007 - Report, Fifth official report of the International Federation of Hospital Engineering (IFHE), January 2007
3. Gupta, Kant, Chandrashekhar, Satpathy, Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM, Jaypee Medical publishers, 1/e, 2007
4. Sakharkar, Principles of Hospital Administration and Planning, Jaypee Medical publishers 1/e, Reprint 2004

BM E74 ANESTHESIA

UNIT I

Introduction & Gas Laws, Differential Pressure Flowmeters, Variable-Area Flowmeters, Anemometry, Spirometers.

UNIT II

Introduction, Vaporizing Systems (Draw-Over Systems), Other Factors Affecting Vapour Concentration, Summary of Vaporizer Performance, Calibration of Vaporizers, Examples of Vaporizers: Boyle's Vapourisers & its use. Definitions of Humidifiers, Importance of Humidification, Examples of Humidification Equipment.

UNIT III

The Continuous Flow Anesthetic Machine - Introduction, Machine Framework, Pin Index System for Gas Cylinders, Other Types of Gas-Tight Connections Within the Machine, Pressure Gauges, Pressure Regulators, (Reducing Valves), The Back Bar, Safety Features, The Common Gas Outlet, Auxiliary Gas Sockets. Maintenance of Anesthetic Machines. Electronics in the Anesthetic Machine - Introduction, Ergonomics, Control Engineering, New Components, An Electronically Controlled Anesthetic Machine, Servo-controlled Anesthesia.

UNIT IV

Breathing Systems & Nonbreathing Systems - Definitions, Classification of Breathing Systems, Classification of Systems with Potential for Rebreathing- Mapleson A breathing system, Mapleson A & controlled ventilation. Mapleson D system with spontaneous respiration, Mapleson D system with controlled ventilation, Non Rebreathing Systems- Anesthetic non Rebreathing system which include CO2 absorption.

UNIT V

Introduction to Monitoring of Gases, Inspired Oxygen Concentration (working principle of Galvanic Oxygen fuel cell, Servomex paramagnetic oxygen analyzer, Nitrous Oxide and the Volatile Agents: The Riken gas indicator, Bruel & Kjaer Anesthetic gas monitor, Raman anesthetic gas monitor, Hewlett- Packard main stream carbon dioxide gas analyzer. Anesthetic Room: Introduction, Layout of the Anesthetic Room, Contents of the Anesthetic Room.

TEXT BOOKS

1. Jerry A Dorsch (Author), Susan E Dorsch (Author), Understanding Anesthesia Equipment (Hardcover), Lippincott Williams & Wilkins publishers; Fifth Edition, October 2007

REFERENCE BOOKS:

1. R Chandrasekaran, R Lakshmi, Essentials of Anaesthesia For Undergraduates, Jaypee Medical Publishers, 2006

2. Vasumathi M Divekar, Anaesthesia And Resuscation For Medical Students And Practitioners, Jaypee Medical Publishers, 2000
3. Rajeshwari Subramaniam, A Primer Of Anesthesia, Jaypee Medical Publishers, 2008
4. Ward's Anaesthetic Equipment" by Andrew Davey, John T. B. Moyle & Crispian S. Ward, 3rd edition.
5. A Text book of Anaesthesia by R. D. Miller.

BM E75 VIRTUAL INSTRUMENTATION

UNIT 1

Review of Virtual Instrumentation, Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II

Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input.

UNIT III

Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.

UNIT IV

Common Instrument Interfaces for Current loop, RS 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control.

UNIT V

Use of Analysis Tools, Fourier transforms Power spectrum, Correlation methods, windowing & flittering. Application of VI: Application in Process Control Designing of equipments like Oscilloscope, Digital Millimeter using Lab view Software, Study of Data Acquisition & control using Lab view Virtual instrumentation for an Innovative Thermal Conductivity Apparatus to measure the Thermal Conductivity Apparatus- to measure the conductivity of non Newtonian fluids white they are subjected to sharing force.

TEXT BOOKS

1. Virtual instrumentation using Lab View, Sanjay gupta, Tata McGraw Hill Publishing, first reprint, 2006.

REFERENCE BOOKS

1. Labview Graphical Programming, “Gary Johnson”, second edition, MC GrawHill, Newyork, 1997
2. Labview for everyone, “Lisa K. Wells & Jettrey Travis”, Prentice Hall, New Jersey, 1997.
3. Basic Concepts of Labview 4, “Sokoloff”, Prentice Hall, New Jercy, 1998.
4. PC interfacing for Data Acquisition & process control, “S. Gupta, J.P.Gupta”, second Edition, Instrument Society of America, 1994.

BM E76 COMMUNICATION ENGINEERING

UNIT-I

Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM – Power relation –Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.

UNIT-II

Principles of pulse modulation – sampling theorem, PAM – PWM – PPM– Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction to digital modulation systems – PCM, ASK, FSK and PSK.

UNIT- III

Microwave communication systems: advantage, block diagram of a microwave radio system, microwave radio stations- Terminal station and repeater station.
Satellite Communication system: Satellite Orbits, launch vehicles, look angles, satellite parameters, satellite link model, personal communication systems- GPS services.

UNIT- IV

Need for fiber optics, introduction to optical fiber, principle of light transmission through a fiber, fiber characteristics and classification, various fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system- Power budget analysis for a optical link- Recent applications of fiber optics.

UNIT -V

Cellular concept, basic cellular concept and its operation, uniqueness of mobile radio environment- Performance metrics in cellular system-Elements of cellular mobile radio- Handoff- Frequency management and channel assignment- Introduction to various cellular standards like AMPS, GSM, GPRS, IS-95A, IS-95B, CDMA-2000 and WCDMA.

TEXT BOOK:

1. Kennedy Davis, “Electronic Communication Systems”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1999.
2. Wayne Tomasi, “Electronic Communication Systems”, Pearson education Private Limited, Delhi, 2004.

REFERENCE BOOKS:

1. Roddy D and Coolen J, “Electronic Communications”, Prentice Hall of India Private Limited, fourth edition, 2007.
2. William C.Y. Lee, “Mobile Cellular Telecommunication Systems”, McGraw Hill International Edition, Second edition, 2006.
3. Gerd Keiser, “Optical fiber Communications”, McGraw Hill International Edition, Foutth edition, 2006.

BM E77 ELEMENTS OF BIOTECHNOLOGY

UNIT-I

What is Biotechnology, Biotechnology -an interdisciplinary pursuit, public perception of Biotechnology, Biotechnology and the developing world? Classification of micro-organisms, The cell, its organelles and their respective functions, Basic metabolism of cells, DNA – Structure and function, RNA-Structure and function.

UNIT-II

Enzyme Technology: Proteins, Protein Structure & Function, Protein –Protein interactions, The nature of enzymes, application of enzymes, Technology of enzyme production, immobilized enzymes.

UNIT-III

Biotechnology and Medicine: Introduction, Pharmaceuticals and bio-pharmaceuticals, Antibiotics, vaccines and monoclonal antibodies, gene therapy. Biotechnology and Environment: Introduction, Microbial ecology / environmental biotechnology, waste water and sewage treatment, landfill technologies, composting, bioremediation, microbes and the geological environment, sustainability.

UNIT – IV

Genetics and Biotechnology: Introduction, industrial genetics, protoplast and cell fusion technologies, genetic engineering, Introduction to Bio-informatics, potential lab biohazards of genetic engineering, Bioethics.

UNIT V

Biotechnology in Agricultural, food and Beverage industries: Introduction, plant biotechnology, diagnostics in agriculture, food and beverage fermentation, speciality fermentation products e.g.: biopolymers, bio-pesticides, miscellaneous microbial derived food products.

TEXT BOOKS

1. Bailey, J.E. and D.F. Ollis. 1986. Biochemical Engineering Fundamentals, 2nd Ed. McGraw-Hill, New York.

REFERENCE BOOKS:

1. Shuler, M.L. and F. Kargi. 1992. Bioprocess Engineering, Prentice-Hall, Englewood Cliffs, NJ.
2. Biotechnology by Smith, Cambridge Press.
3. Modern Concepts of Biotechnology by H.D. Kumar, Vikas Publishing House Pvt. Ltd.
4. Elements of Biotechnology by P.K. Gupta, Rastogi Publications.

BM E81 NANOTECHNOLOGY IN MEDICINE

UNIT I

Introduction to Physics of Solid State: Intermolecular forces: thermodynamic aspects - Quantum Mechanical Treatment of the Many-Particle Problem - Potential Energy Surface - Pair Potential Approximation - Advantages and Limitations of the Pair Potential Approximation - Phenomenological Potentials - Pseudo-Potentials - Many-Body Potentials.

UNIT II

Fundamentals of Nanoscience: Size dependence of properties - Particle size determination - Bulk to nano transition - Semiconducting nanoparticles - Carbon nanostructures - Mechanical properties (hardness, ductility, elasticity) - Optical properties of nanotubes - Electrical properties of nanotubes.

UNIT III

Preparation of Nanosystems: Introduction to nanolithography - Carbon nanotubes: preparation - Synthesis and preparation of nanomaterials (crystalline and thinfilm) - Physical and chemical methods - Control and stability (size, shape, composition).

UNIT IV

Characterization of Nanosystems: Thermal Stability - Basic Material Properties - Mean Values and Correlation Functions - X-ray diffraction - Scanning Electron Microscopy - Scanning Tunneling Microscopy - Electron Microscopy - X-ray absorption spectroscopy – Photoelectron emission spectroscopy.

UNIT V

Applications: Potential of nanotechnology in medicine - Nanotubes, nanowires, and nanodevices-introduction - Functional Nanostructures – Introduction to molecular electronics - Field emission and Shielding - Microelectromechanical systems (MEMs) - Nanoelectromechanical systems (NEMs) - Molecular and Supramolecular Switches – Biosensors – Qdots – Nanoshells – Nanobiotix – Cancer detection – Drug Delivery using Nanoparticles and Molecular Carriers.

TEXT BOOKS

1. Di Ventra, Massimiliano; Evoy, Stephane; Heflin, James R., Introduction to Nanoscale Science and Technology, Springer publications, 2004 (UNITS I, II, III & IV)
2. Vinod Labhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications Of Nanotechnology, Wiley-Interscience A John Wiley & Son, Inc., Publication, 2007 (UNIT V)

REFERENCE BOOKS

1. Chattopadhyay, Introduction to Nanoscience and Naotechnology, PHI, 2009
2. B.k. Parthasarathy, Nanoscience And Nanotechnology, Gyan Books, 2007

3. Vicki H. Grassian, Nanoscience And Nanotechnology: Environmental And Health Impacts (Hardcover - 2008), John Wiley & Sons
4. T. Pradeep, Nano – The essentials, McGraw-Hill publishers, 2008
5. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer publications, 2nd rev. and extended ed., 2007
6. Tuan Vo-Dinh, Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, CRC Press, Jan 2007

BM E82 MODELING OF PHYSIOLOGICAL SYSTEM

UNIT I

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Purpose of physiological modeling and signal analysis, linearization of nonlinear models. Time invariant and time varying systems for physiological modeling.

UNIT II

Nonparametric modeling: Volterra models. Wiener models. Efficient volterra kernel estimation Analysis of estimation errors. Parametric modeling: Basic parametric model forms and Estimation procedures. Volterra kernels of nonlinear differential equations. Discrete-time volterra kernels of NARMAX models. From Volterra kernel measurements to Parametric models. Equivalence between continuous and Discrete -parametric models.

UNIT III

Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of the whole neuron. Huxley model of isotonic muscle contraction, modeling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.

UNIT IV

Physiological modeling: Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

UNIT V

Electrical circuit model of oxygenation. A model of immune response to disease (Block Diagram). Modeling of multi input/multi output systems: The Two-input case. Application s of Two-input modeling to physiological systems. The Multiinput case spatiotemporal and spectrotemporal modeling.

TEXT BOOKS

1. Michel C Khoo, Physiological Control Systems -Analysis, simulation and estimation, Prentice Hall of India, 2001.

REFERENCE BOOKS:

1. David T. Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley-IEEE Press, 2003.

2. Endarle, Blanchard & Bronzino, Introduction to Biomedical Engg. , Academic press.
3. Suresh.R.Devasahayam, Signals & Systems in Biomedical Engineering, Kluwer Academic/ Plenum Publishers.
4. V.Z. Marmarelis, Advanced methods of physiological modeling, Plenum Press.
5. J. Candy, Signal Processing: The Model Based approach, Mc. Graw Hill.
6. L.Stark, Neurological Control System, Plenum Press.
7. R.B. Stein, Nerve and Muscle, Plenum Press.

BM E83 ARTIFICIAL ORGANS & REHABILITATION ENGINEERING

UNIT I

Introduction to artificial organs: Biomaterials used in artificial organs and prostheses, inflammation, rejection, correction. Rheological properties of blood, blood viscosity variation: effect of shear rate, hematocrit, temperature and protein contents. Casson equation, flow properties of blood through the blood vessels, problems associated with extracorporeal blood flow.

UNIT II

Artificial kidney: Brief of kidney filtration, basic methods of artificial waste removal, hemodialysis, equation for artificial kidney and middle molecule hypothesis. Hemodialysers: flat plate type, coil type and hollow fiber. Analysis of mass transfer in dialyers (cross current & cocurrent flow), regeneration of dialysate, membrane configuration, wearable artificial kidney machine, separation of antigens from blood in ESRD patients.

UNIT III

Artificial heart-lung machine: Brief of lungs gaseous exchange / transport, artificial heart-lung devices. Oxygenators: bubble, film oxygenators and membrane oxygenators. Gas flow rate and area for membrane oxygenators. Liver support system, artificial pancreas, blood and skin.

UNIT IV

Audiometry: air conduction, bone conduction, masking, functional diagram of an audiometer. Hearing aids: different types, receiver amplifiers. Opthalmoscope, retinoscope, I.A.B.P principle and application.

UNIT V

Rehabilitation Engineering: Impairments, disabilities and handicaps, Measurement and assessment. Characterizing engineering concepts in sensory and motor rehabilitation. Engineering concept in communication disorders. Rehabs for locomotion, visual, speech & hearing. Artificial limb and hands, prosthetic heart valves. Externally powered and controlled orthotics and prosthetics. Myoelectric hand and arm prostheses. The marcus intelligent hand prostheses, gait study, spinal rehabilitation

TEXT BOOKS:

1. Robbinson C.J., Rehabilitation Engineering. CRC press 1995
2. Gerald E. Miller, Artificial Organs, Morgan &Claypool Publishers, 2006

REFERENCE BOOKS:

1. Bronzino. Joseph, Hand book of biomedical engineering. CRC; 2 Sub edition, 1999
2. R.S.Khandpur, Hand book of biomedical instrumentation. Tata Mcgraw Hill Publishers, 1/e.

3. David O. Cooney., Biomedical Engineering Principles (Volume – II). Marcel Dekker Inc.
4. Ballabio E.etal, Rehabilitation Engineering. IOS press 1993.

BM E84 VLSI DESIGN

UNIT - I

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design-Gate realization using CMOS-Introduction to Reconfigurable Hardware – HDL basics.

UNIT – II

VHDL basics - VHDL levels of abstraction - Abstraction and timing - The VHDL design flow - VHDL design entities - Entity declarations - Architectures - Using libraries and packages - Concurrent signal assignments - Signal assignments with delays.

UNIT – III

Component declarations - Component instantiation - Named port mapping - Positional port mapping - Direct instantiation - Configuration specifications - Entity binding
Port modes - VHDL processes - Processes sensitivity lists - Objects in VHDL - Constants, variables and signals - VHDL types - Scalar types - Arrays – Records - Custom types and subtypes

UNIT – IV

Concurrent statements - Sequential statements - Conditional & selective signal assignments - The generate statement - Signal and variable assignments -
For loops - Subprograms – Functions – Procedures - Differences between functions and procedures - Subprogram declarations – Packages - Package declaration - Package body.

UNIT – V

VHDL synthesis - Modeling hardware in VHDL - VHDL models for multiplexers, Encoders, Decoders, Parity Generators – combinational circuit implementation - compilation and simulation of VHDL code, modeling a sequential machine, Test bench development.

Text Book :

1. J. Bhasker, VHDL Primer, Prentice Hall, 3rd edition, 1998.

References:

1. Chip Design for Submicron VLSI: CMOS Layout & Simulation, - John P. Uyemura, Thomson Learning.
2. Introduction to VLSI Circuits and Systems - John .P. Uyemura, JohnWiley, 2003.
3. Digital Integrated Circuits - John M. Rabaey, PHI, EEE, 1997.
4. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.

BM E85 ROBOTICS AND AUTOMATION

UNIT – I

Robotics – Basic components – Classification – Performance characteristics – Drives and control systems – Electric, hydraulic and pneumatic actuators – control loops using current amplifier and voltage amplifiers.

UNIT – II

Sensors and vision systems: Transducers and sensors – Tactile sensors – Proximity and range sensors – vision systems – Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT – III

End effects – type – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface = software for industrial robots. Positive stop program, point to point program, and continuous path program.

UNIT – IV

Robot motion analysis and control: Manipulator kinematics – Homogeneous transformations and robot Kinematics Robot dynamics Configuration of a robot controller.

UNIT – V

Industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

Text Books:

1. Yoran Koren, “Robotics of Engineers”, McGraw Hill 1980.
2. Mikel P. Grover , et. Al. “Industrial Robots – Technology Programming and Applications”, McGraw Hill, 1980.

BM E86 TISSUE ENGINEERING

UNIT I

Introduction: Basic definition, Structural and organization of tissues: Epithelial, connective; vascularity and angiogenesis, basic wound healing, cell migration, current scope of development and use in therapeutic and in-vitro testing.

UNIT II

Cell culture: Different cell types, progenitor cells and cell differentiations, different kind of matrix, cell-cell interaction. Aspect of cell culture: cell expansion, cell transfer, cell storage and cell characterization, Bioreactors.

UNIT III

Molecular biology aspects: Cell signaling molecules, growth factors, hormone and growth factor signaling, growth factor delivery in tissue engineering, cell attachment: differential cell adhesion, receptor-ligand binding, and Cell surface markers.

UNIT IV

Scaffold and transplant: Engineering biomaterials for tissue engineering, Degradable materials (collagen, silk and polylactic acid), porosity, mechanical strength, 3-D architecture and cell incorporation. Engineering tissues for replacing bone, cartilage, tendons, ligaments, skin and liver. Basic transplant immunology, stems cells: introduction, hepatopoiesis.

UNIT V

Case study and regulatory issues: Case study of multiple approaches: cell transplantation for liver, musculoskeletal, cardiovascular, neural, visceral tissue engineering. Ethical, FDA and regulatory issues of tissue engineering.

TEXT BOOK

1. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008

REFERENCE BOOKS:

1. Principles of tissue engineering, Robert. P.Lanza, Robert Langer & William L. Chick, Academic press.
2. The Biomedical Engineering –Handbook, Joseph D. Bronzino, CRC press.
3. Introduction to Biomedical Engg. , Endarle, Blanchard & Bronzino, Academic press.
4. Tissue Engineering, B. Palsson, J.A. Hubbell, R.Plonsey & J.D. Bronzino, CRC-Taylor & Francis

BM E87 BIOMEDICAL IMAGE ANALYSIS

UNIT I

Introduction - Driving problems in biomedical imaging - Sources of imaging data: acquisition and noise - Elementary image processing - Grenander's Pattern Theory

UNIT II

Edge detection and active snakes - Intensity-driven methods: expectation-minimization, Markov random fields - Graph cut algorithms for image segmentation - Shape-driven methods: active shape/appearance models, problems of correspondence - Level set methods - Skeletonization and medial methods

UNIT III

Hands-on introduction to Image registration - Geometric mappings - Numerical methods and optimization in registration - Parametric deformable registration - Non-parametric deformable registration - Image match metrics in registration – Applications.

UNIT IV

Introduction to functional Neuroimaging - Hypothesis testing and statistical mapping; permutation tests - Cortical surface segmentation and flattening - Diffusion tensor imaging

UNIT V

Biomedical image analysis using MATLAB – Image registration – unaided and Interactive – Segmentation – Edge detection – Real time imaging applications

TEXT BOOKS

1. John.L.Semmlow, Biomedical signal and Biomedical Image Processing – MATLAB based applications, Marcel Dekker Inc., 2004. (UNIT V)
2. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC press (UNIT I to IV)

Infrastructure and Faculty requirement for B.Tech. BIO-medical Engineering

Sl.No	Name of the Laboratory	Area (sq.m)	Maximum batch Size	No. Required
1	Class Room s	66	66	3
2	Devices and Circuits Lab	100	22	1
3	Electronic measurement Lab	100	22	1
4	Process Control Lab	100	22	1
5	Microprocessor lab	100	22	1
6	Simulation Lab	100	22	1

Requirement of Teaching and Non – Teaching Staff:

Teaching:

The number of faculty members required would be as per AICTE norms and course curriculum

Faculty: Student Ratio = 1:15

A total of 12 faculty members are required including a teaching faculty for mathematics (180/15)

Non Teaching Staff :

Teaching: Non Teaching = 1:1,2

Each laboratory should have one laboratory attender/Mechanic. In addition, one more attender is required for department office.

Total requirement of Non Teaching Staff is = 10 (9 Technical + 1 Non Technical)

Faculty Qualification:

A First Class B.E/ B.Tech., Degree in Biomedical Engineering/Electronics and Instrumentation Engineering / Instrumentation and control ENgineering (or)

A First Class M.E/M.Tech ., degree in the specification of Biomedical Engineering/Biomedical Instrumentation

ELECRON DEVICES AND CIRCUIRTS LABORATORY

LABORATORY

REQUIREMENT FOR A BATCH OF 22 STUDENTS

Carpet area required 100 sq.m

S.No.	Description of Equipment	Quantity required
1.	Regulated Power Supply	10
2.	Dual Tree CRO (20 MHz)	10
3.	Function Generator	10
4.	$3^{1/2}$ Digit digital multimeter	8
5.	Bread Boards	30
6.	Transistor	20 Nos.
7.	JFET	10 Nos.
8.	Diode	10 Nos.
9.	Zener Diode	5 Nos.
10.	UJT, SCR ,DIAC , TRIAC	Each 5 Nos.
11.	Photo Diode	5 Nos.
12.	Photo Transistor	5 Nos.
13.	Transformer (230, 12-0-12)	5 Nos.
14.	OP-amp	10 Nos.
15.	Milli Ammeter (0-100mA)	10 Nos.
16.	Micro Ammeter (0-50µA)	8 Nos.
17.	Low range voltmeter (0-30V)	8 Nos.
18.	Inductance box	5 No.s
19.	Resistor of various ranges	50 Nos.
20.	Capacitors of various ranges	50 Nos.
21.	Connecting wires	Sufficient Nos

STRENGTH OF MATERIALS LAB

REQUIREMENT FOR A BATCH OF 22 STUDENTS

Carpet Area 200 sq.m.

1. Spring Testing Machine
2. Universal Testing Machine
3. Torsion Testing Machine
4. Vicker's Hardness Testing Machine
5. Impact Testing Machine
6. Hardness Testing Machine

LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB

Requirement for a batch of 22 students

Carpet area required 100 sq.m

S.No.	Description of Equipment	Quantity required
1.	A/D, D/A converter ICs	4 each
2.	CRO and function generator	3 each
3.	IC trainer Kit	10
4.	Analog AC trainer kit	4
5.	Components and bread boards	10
6.	Chips IC – 7400	10
7.	Chips IC – 7402	10
8.	Chips IC – 7408	10
9.	Chips IC – 7432	10
10.	Chips IC – 7410	25
11.	Chips IC – 555	10
12.	Chips IC – 741	10
13.	Chips IC – 74153	10
14.	Chips IC – 7474	10
15.	Chips IC – 7490	10
16.	Chips IC – 7447	10
17.	Chips IC – 7476	10
18.	Chips IC – 7420	10
19.	Chips IC – 7404	15

S.No.	Description of Equipment	Quantity required
20.	Chips LM – 317	10
21.	Chips LM – 723	10
22.	Chips MA – 7840	10
23.	Chips LM – 380	10
24.	Chips ICL - 8038	10
25.	Traffic light control kit	2
26.	VDU	2
27.	7 segment Display	5
28.	Interfacing card such as keyboard etc.	3 each
29.	Work tables	15

MEDICAL INSTRUMENTATION LAB

Equipment List
Batch Size:22 Carpet Area 100 sq.m.

1. Sphygmomanometer & Stethoscope (Bell type) - 5 No's
2. Setup for Nerve conduction velocity studies (with Nerve stimulator) – 5 No's
3. Real-time data acquisition system – 5 No's
4. Multichannel Physiological Recorder for ECG, EMG, EEG, heart sounds, Peripheral pulse - 6 No's
5. Breathing rate Measuring instrument (Strain gauge and Thermistor type) Respiration Monitor - 3 No's
6. Tuning Forks - 5 Nos of different frequencies

BIO-ENGINEERING AND COMPUTATION LAB

Equipment required for a batch of 22
Carpet Area 100 sq.m.

1. Transducers trainer kits for Transducer studies – 3 Nos
    a. Strain gauge,
    b. Photoelectric ,
    c. Temperature,
    d. Piezo-electric,
    e. Ultrasound Transducer
    f. PhoTo Transducer and
    g. Thermoelectric Transducers

2.Trainer kits for Electrodes characteristics studies – 2 Nos
    h. Polarized Electrodes,
    i. Non-polarized Electrodes,
    j. Multi Point Electrodes.

3 Audiometer - 2 Nos

4.MATLAB software with Signal Processing toolbox

5.Personal computers

BIOMEDICAL SIGNAL PROCESSING LAB

Equipment required for a batch of 22
Carpet Area 100 sq.m.

1. FFT – analyzer – 10 No's
2. Data acquisition and signal processing software - 1 No
3. Arrhythmia generator – 10 No's
4. Digital Storage CRO – 10 No's
5. Biomedical transducers for ECG, EMG (Ring electrodes, Thermistor) – 5 Sets
6 Spectrum Analyzer – 5 No's
7. Blood pressure meter (Digital Type) – 3 No's
8. MATLAB (Signal Processing Tool box)

MEDICAL INFORMATICS & EXPERT SYSTEMS LAB

Equipment required for a batch of 22
Carpet Area 100 sq.m.

1. C compiler
2. Visual Programming
3. Personal computers – 25 No's

SIMULATION LAB

Equipent required for a batch of 22 students

Carpet area required 100 sq.m

Personal Computers 25
Pspice software

ELECTRONIC CIRCUITS LABORATORY

Equipment required for a batch of 22 students

Carpet area required 100 sq.m

1. Servo voltage stabilizer 5KVA

2. LCR Q – Meter
3. CRO –Digital Storage type (60 Mhz, 2 Ch DSO)
4. Function Generator (10 Mhz with sine , with sine, square triangular pulse & FM output
5 20 V Pp Max)
6. Signal Generators
7. Analog Multimeter
8. Digital Handy Multimeter (Table Top 4 ½ digits)
9. Linear IC trainer kit
10.Digital IC trainer kit
11.Regulated power supply (30 V / 5A Variable & Fixed o /p)
1. Digital IC's

Components and bread boards	10
Chips IC – 7400	10
Chips IC – 7402	10
Chips IC – 7408	10
Chips IC – 7432	10
Chips IC – 7410	25
Chips IC – 741	10
Chips IC – 74153	10
Chips IC – 7474	10
Chips IC – 7490	10
Chips IC – 7447	10
Chips IC – 7476	10
Chips IC – 7420	10
Chips IC – 7404	15

DESIGIN PROJECT LAB

List of equipments/components for 22 students (two per batch)

Carpet area required 100 sq.m

1. Synthesized Function Generator	1
2. regulated Power Supply	10
3. Rheostat	10
4. Temperature controlled furnace	2
5. Digital IC tester	1
6. Analog IC tester	1
7. Hot plate	2
8. Multi function calibrator	1
9. Function Generators	6
10. Oscilloscopes	6
11. Magnetic and photoelectric pickup trainer	1

MICROPROCESSORS AND APPLICATIONS LAB

List of equipments/components for 22 students (two per batch)

Carpet area required 100 sq.m

1. 8085 Trainer Kit with onboard 8255, 8253, 8279 and 8251 – 12 nos.
2. TASM/MASM simulator in PC (8086 programs) – 20 nos.
3. Interfacing with 8085 and 8086 – PC add-on cards with 8255, 8253, 8279 and 8251 – 15 nos.
4. Stepper motor interfacing module – 2 nos.
5. Traffic light controller interfacing module – 2 nos.
6. ADC, DAC interfacing module – 2nos.
7. CRO's – 5 nos.
8. Digital multimeters-5 No.s

DIGITAL IMAGE PROCESSING LAB

Equipment required for batch of 20 carpet are; 100 sq.m.

1. **MATLAB image Processing**
2. **Personal computers – 25 No's**

BIOMEDICAL EQUIPMENTS LAB

Equipments required for batch size of 22

Carpet Area 100 sq.m.

1. ECG heart rate monitor with alarm system - 2 Units
2. Peripheral pulse rate monitor with alarm system – 2 units
3 Apnea monitor - 2 Units
4. EMG biofeedback system - 1 unit
5. ECG simulator - 1 Unit
6. ECG telemetry unit. - 1 Unit
7. Audiometer - 1 Unit
8. External Pacemaker & DC Defibrillator – 1 Unit (with patient simulator)
9. Short-wave Diathermy, Ultrasonic Diathermy & Surgical Diathermy Unit – each 1 Unit
10. Special storage oscilloscope with facility for automatic - 10 No's

EI P83 COMPREHENSIVE VIVA-VOCE

The student will be tested for his understanding of basic principles of the core Biomedical Engineering Engineering subjects. The internal assessment for a total of 50 marks will be made by an internal assessment committee. The committee will conduct two written examinations of objective or short questions type from the all the core subjects. The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

EI PW8 PROJECT WORK (PHASE II)

Project work phase II will be an extension of the project work started in the seventh semester. On completion of the work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee for 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.