राष्ट्रीय प्रौद्योगिकी संस्थान रायपुर
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COURSE OF STUDY AND SCHEME OF EXAMINATION OF B.TECH/B.ARCH/M.TECH/M.C.A.
NATIONAL INSTITUTE OF TECHNOLOGY, RAIPUR

Branch- Biomedical Engineering **Course- B.Tech.(NIT Scheme)**
Semester- V

S. No.	Board of Studies	Sub. Code	Subject Name	Periods/Week			Examination Scheme					Total Mark	Credits L+(T+P)/2
				L	T	P	TA	FE	SE	ESE	Prac. ESE		
1	Biomedical Engg	BM20511BM	Biomedical Equipments	3	1	-	20	15	15	70	-	120	4
2	Biomedical Engg	BM20512BM	Microprocessor	3	1	-	20	15	15	70	-	120	4
3	Biomedical Engg	BM20513BM	Biological control Systems	3	1	-	20	15	15	70	-	120	4
4	Biomedical Engg	BM20514BM	Basic Clinical Science-1	3	1	-	20	15	15	70	-	120	4
5	Biomedical Engg	BM20515BM	Principal of Communication System	3	1	-	20	15	15	70	-	120	4
6	Biomedical Engg	BM20516BM	Microelectronics and integrated circuits	4	1	-	20	15	15	70	-	120	5
7	Biomedical Engg	BM20521BM	Microprocessor & Principal of Communication system Lab	-	-	3	30	-	-	-	20	50	2
8	Biomedical Engg	BM20522BM	Biomedical Equipments Lab	-	-	3	30	-	-	-	20	50	2
9	Biomedical Engg	BM20523BM	Microelectronics and Integrated circuits Lab	-	-	3	30	-	-	-	20	50	2
10	Humanities	EN20524BM	Managerial skill	-	-	2	25	-	-	-	-	25	1
11			Discipline	-	-	-	25	-	-	-	-	25	1
			Total	19	6	11	260	90	90	420	60	920	33

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biomedical Equipments	Subject code	BM20511BM
Semester	Fifth	Board of Studies	Biomedical Engg
Maximum Marks	120	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4

Unit I- Defibrillators & concepts of coronary care Basics, AC defibrillators, DC defibrillators, capacitance discharge and delay line capacitance discharge, defibrillator waveforms, electrodes used with defibrillators: types and their features, Cardioverters: working, principles.Systems Organization, critical physiological characters to be monitored, and layout and safety precautions

Unit II- Cardiac pacemakers & Heart lung machine Pacemaker: Modes of operation (Asynchronous and Synchronous), External and Implantable; Block diagram and circuit diagram of a blocking oscillator asynchronous pacemaker.Implantable pacemakers: Technical and qualitative requirements of power supplies, transcutaneous RF powered Cardiac pacemaker systems, susceptibility of implantable pacemakers to electrical interference and remedial measures, Lead wires and electrodes used with pacemakers.Heart lung machine: Governing principles, qualitative requirements, functional details of bubble, thin film, and membrane type of blood oxygenator

Unit III- Electrosurgical Unit & Electrical Hazards in hospitals Electro-surgical unit: Principles of cutting, coagulation, fulguration; Electrosurgical generators: spark gap & solid state generators, Safety features.Electrical hazards in hospitals: Patient electrical safety, types of hazards, patient isolation, physical effects of current, let go current, Micro shocks, different ways for electrical accident to occur, safety instruction circuits, electrical grounding & effects.

Unit IV-Haemodialysis& Ultrasound Haemodialysis: Qualitative requirements, general scheme of operations, types of exchangers, block diagram electronic control & monitoring Systems.
Ultrasound: Characteristics of Ultrasound, Ultrasound Transducers, Different Modes of operations, Characteristics of Ultrasound beams, interaction between ultrasound and matter, design and application of real time ultrasound machine, Doppler techniques, Doppler transducer and modes of operation, color Doppler

Unit V- X Rays, Computed Tomography & Magnetic Resonance Imaging
x-ray: Production Of X-rays, X-rays generators, properties of X-rays, basic interaction between X-ray and matter, X-ray grids, detection of X-ray.
computed tomography: Basic Principle, generations of CT scan machines, data accumulation, data handling system, component of CT scan machine, factors of image quality.
magnetic resonance imaging: Principle of MRI, Elementary physics of MRI, Nuclear magnetic resonance, Magnetic field gradient, Bloch equation, Receiver-transmitter and different RF coils for MRI machines

TEXT BOOKS

1. John C. Webster, Medical Instrumentation Leighton, Mifflin Co Boston, USA
2. R. S. Khandpur Handbook of Biomedical Instrumentation, Tata McGraw hill, Pub. Co. Ltd., New Delhi.
3. Applied Biomedical Instrumentation, La Geddes and L.E. Baker

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Microprocessor	Subject code	BM20512BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	120	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4

Unit I-Architecture & Instrument set Introduction to Microprocessor, architectures of 8085, Pin configuration and function; internal register & flag register, Generation of control signals; Bus Timings; De-multiplexing of address /data bus, Fetch Cycle , Execute Cycle, Instruction Timings and Operation Status, Instruction for data Transfer, Arithmetic and Logical Operation, Batching Operation: Machine Cycle concept, Addressing Modes, Instruction Format, Stacks Subroutine and Related instructions. ElementaryConcepts of Assemblers, Assemblers Directives

Unit II-Timing diagram and Programming
Timing Diagram, Looping, Counting and indexing Software Counters with Time Delays, Simple Programming using instruction Set of 8085, Debugging and Programs involving Subroutines, Programs for code (conversion e.g. BCD to Binary to Seven segment Led Display, Binary of ASCII, ASCII & Binary. Program for Addition Subtraction, Programs for Multiplication and Division of Unsigned binary Numbers; Data transfer schemes: Serial, Parallel data transfer schemes

Unit III-Interrupts
8085 interrupts H/W, S/W interrupts, maskable / non maskable interrupts, vectored / nonvectored interrupts, 8085 interrupts structure, interrupt priorities. RIM and SIM instruction, Pending interrupts. Use of Interrupt and Handshaking Signals in interfacing.Application of interrupts and Illustrative Programs.

Unit IV-Memory & I / O Interfacing
memory interfacing with 8085. Absolute & Partial decoding. I/O mapped I/O , memory mapped I/O, Architecture & Interfacing of 8255, 8155/8156. 8355/8755, 8253/8254 with 8085.Direct memory acess

Unit V-Advanced Microprocessor
Architecture & Pin diagram of 8085. Comparison of 8085 & 8086, Instruction Format & Addressing modes of 8086. Architecture of 80386 & Pentium-4 microprocessors.

TEXT BOOKS

1. Microprocessor Architecture, Programming and Application by R.S. Gaonkar , Wiley Eastern.
2. Microprocessor System: 8086/8088 Family- Architecture, Programming and Design; Y.Liu and G.A. Gibson, 2nd Ed, PHI.
3. Microprocessor & Interfacing – D. Hall, TMH.
4. Digital System – From Gates to Microprocessor by Sanjay K. Bose, New Age International Publisher.
5. 8085 Microprocessor Programming & Interfacing --- N.K. Srinath, PHI.
6. Digital Computer Electronics – malvino, TMH.
7. Microprocessor: Theory and Application – Intel and Motorolla, Rafiquuzzaman, PHI.
8. 0000 to 8085: Introduction to Microprocessor for Engineers for Scientist, Scientists, Ghosh& Sridhar, PHI.

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biological Control System	Subject code	BM20513BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	120	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1		4

Unit I-Introduction to control systems &Mathematical modeling of control system
Introduction to control system:Open loop and closed loop system and illustrations.
Mathematical modeling of control system: Block diagram representation of control system; Transfer function, Block reduction techniques and Signal flow graphs. State space Analysis; AC-DC servo motors, characteristics of feed back and feed forward back control system.

Unit II-Stability & Time domain analysis
Stability: Concept of stability, Necessary conditions for stability, Pole-zero locations in S-plane forstabilitystudy ;Routh and RouthHerwitz stability criteria.
Time domain analysis:Use of standard test signals for time response study; Time response 2^{nd}order system.Performance specification steady state error constants. Root locus techniqueconceptand construction of root locus and driving stability information.

Unit III-Introduction to physiological control system & Human thermal systems
Introduction to physiological control system:Physiological system differential equations,Modeling the body as compartments, behavior in simple compartmental system, pharmacykinetic model, urea distribution model, basics of zero order and first order chemical kineticbehavior.Human thermal systems:Heatproduction.Loss of heat to environment. Heat transfer withinthe body.Thermo regulation.

Unit IV-Frequency domain analysis
Frequency domain analysis:Closed loop frequency response performance specifications; frequency response curve; Relationbetween time and frequency domain specification. Polar plot; Bode plots-gain margin and phasemargin for stability determination.Derivation of transfer function form Bode plots. Nyquist stability Criterion-Stability and relativestability study lines using Nyquist plots.

Unit V-Respiratory models & System
Respiratory models & System,
Cardiovascular control system.Skeletal musclesservomechanism Biological receptors.

TEXT BOOKS

1. The Applications of control theory of physiological system. Howard T. Milhorn Sounders1966
2. Automatic control systems, Benjamin C.KUO, Prentice Hall, India 46th Ed. 1985.
3. Biological Control systems, analysis John. H. Milsun, McGraw Hill 1966.
4. Bio-Medical Engg. Principles. David Ocooney. Marcel Dekken INC. New York and Basel.

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Basic clinical science I	Subject code	BM20514BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	120	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1		4

Unit I: Cardiology &Electrocardiography: Cardiology**:** Review of anatomy and physiology of heart .cardiac output. Electrocardiography: Characteristics of the Normal Electrocardiogram, Method for Recording Electrocardiograms, criteria for selection of ECG lead, Cardiac Arrhythmias and Their Electrocardiographic Interpretation, Effect of changes in electrolyte concentration on heart, cardiac output

Unit II: Cardiac disorders: cardiac disorders:Arial& Ventricular fibrillation, Coronary artery Disease, cardiac flutter cardiac arrest cardiac catheterization, Echocardiography, cine Angiography, Angioplasty, Application & significance of Treadmill & Ergo meter, Open heart surgery, grafts, Bypass surgery, IABP, CVP& SWAN Catheters

Unit III: ENT, Physiology of Ear & related equipments: ENT: Review of the Anatomy & central connections of ear, anatomy of Larynx.
Physiology of ear: mechanics of hearing & equilibrium, auditory receptors, Study of different potential changes in internal ear.
Equipments used: Audiometer-Principles & technique, Hearing Aids: Functional concepts, Ultra sonic binaural sensing aid for the blind.

Unit IV: Receptors & Laser: Study of receptors, generators potential (in detail), study of location of filters & amplifiers at various levels for gain of the signal intensity.
Specialized equipments used in Treatment: cochlear implants, Electronystography, Laser in ENT, CRYO in ENT, Study of different scopies in ENT – principles of scopy
Fundamentals to the Practice of Anesthesia, study of pain Therapy equipments

Unit V:Opthalmology & related equipments: Physiology of eye: Structure & function of Eye, Generation of signals & transmission to brain, Aqueous humor production, Intraocular Pressure
Equipment used:Keratometer, Refractometer, Fundus camera, Ophthalmoscope - direct & indirect, RetinoscopeTonometers: Contact & Noncontact, Ultrasound Scanners, contact Lenses, Intraocular lenses, cryosurgical equipments, Virectomy instruments.

TEXT BOOKS

1. Cardiovascular assist device- Glasser
2. Cardiovascular dynamics – Glasser
3. Cardiovascular physiology – Burton
4. Disease of Eye-Pearson
5. System of Opthamology- Duke Elder
6. essentials of medical physiology-sembulingum
7. Medical physiology –gyuton

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Principal of communication systems	Subject code	BM20515BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	120	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
3	1	3	4

Unit I:Amplitude modulation

Amplitude modulation systems: suppressed carrier system (DSB-SC), signals side band modulation (SSB), vestigial sideband modulation (VSM), amplitude modulation with large Carrier (AM), QAM, Generation of AM waves, de-modulation of AM waves, Frequency division multiplexing, AM Transmitters & Receivers.

Unit II: Angle modulation

Frequency Modulation (FM) & Phase Modulation (PM), Relation between FM & PM, Spectrum of FM, Narrow band FM, Wideband FM, Phasor diagram of AM & FM, FM generation & demodulation, FM transmitters & Receivers, Pre-emphasis & De-emphasis.

Unit III:pulse modulation

Sampling, Sampling theorem, Natural Sampling, Flat top sampling ,PAM, PWM, PPM, Quantization, PCM, DPCM, Delta modulation, Delta sigma modulation, Adaptive delta modulation, Time division multiplexing.

Unit IV:Digital modulation techniques

ASK, BPSK, BFSK, DEPSK, DPSK, QPSK, QASK, MSK, M-ary FSK, M-ary PSK, Probabilty of error for ASK, BPSK, BFSK.

Unit V:Information theory & coding

Information, Entropy, Information rate, Mutual Information, Channel capacity, Types of channels, Joint Entropy, Shannons theorem of channel capacity, Shannons Hartley Theorem, Linear block codes, Cyclic codes, Shannon Fano&Huffmann coding, Convolutional codes.

TEXT BOOKS:

1. Taub& Schilling, Principle of Communication System, 2nd Ed., Tata McGraw Hill.
2. Carlon, Communication System, 4th Ed. Tata McGraw Hill.
3. Kennedy & Davis, Electronics Communication System, 4th Ed. Tata McGraw Hill.
4. B.P. Lathi, Morden and analog Communication System, 3rd Ed. Oxford University Press

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Microelectronics &Integrated circuits	Subject code	BM20516BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	120	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
4	1	3	5

Unit I:Introduction to microelectronics
Monolithic and hybrid integrated circuits - Bipolar and MOSTechnology- Fabrication of active and passive components, bonding packaging.Concept of SSI, LSI, VLSI.

Unit II:Thin film & thick film technologies & differential amplifiers
Introduction to thick film and thin film technologies, resistors & capacitors, comparison- Optical integrated circuits.Differential Amplifiers: DC Amplifier- problems with straight DC amplifier- difference amplifier. Common mode and difference mode operation- CMRR- merits and demerits- use of constant current source, drift and offset problems - current mirror and its use.

Unit III:Intoduction to operational amplifiers,Linear Circuits using Op Amps&Non Ideal effects of Op Amp: Internal structure & block diagram.Characteristics of ideal op-amps.
Inverting amplifier, non-inverting amplifier, instrumentation amplifier, adder, subtractor, log and antilog amplifier, integrator,differentiator, peak detector, precision rectifier.
Offset, drift, finite gain, finite gainbandwidthproducts, finite CMRR , finite R_i, non-zero R_o , slew rate, effect of finite gain or inverting andnon-inverting amplifiers, offset compensation, frequency compensation.

Unit IV:Non linear circuits and filters using op amps & Filters
Nonlinear circuits using op-amp-comparators, multivibrators, function generators, Voltage regulators, functional diagram of 723 voltage regulator, IC short circuit protection.
Active filters – general transfer functions, advantages, design of second order Chebychev and Butter worth filters – low pass, high pass, band pass, band stop, filters – Gyrator – negativeimpedanceconverter, filter using simulated inductance, Universal active filter (KHN) , All pass filters.

Unit V: op-amp applications
Sample & Hold Circuits, 555 timers: principles and working, Introduction to ADC's & DAC's. Phase Locked Loop: Principle of operation, application. Analog Multiplier: Various Types and Applications.

TEXT BOOKS:

1. Boylestead and Nashelesky " Electronic Devices and Circuits " PHI
2. Gayakwad"Op-Amp and Integrated circuits"
3. Clayton "Operational Amplifiers"
4. "Operational Amplifiers" IHRDE Publications
5. "High Frequency Electronics " learning material series, ISTE, New Delhi
6. Sergio Franco "Design with Op-Amps and Analog Integrated Circuits" MH International
7. K.R. Botkar, Integrated Circuit, Khanna Publication.

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Microproceesor& principle of communication lab	Subject code	BM20521BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	50	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
		3	2

LIST OF EXPERIMENTS

1. To study Amplitude Modulation and Demodulation on Trainer kit.
2. To study Frequency Modulation and Frequency Demodulation using Trainer Kits.
3. To generate SSB-SC signal and to study its characteristics.
4. To generate DSB-SC signal using Balanced Modulator and to study its characteristics.
5. To design a square Law modulator using FET and to study its characteristics.
6. To design a ring modulator and to study its characteristics.
7. To design a square Law detector using diode and to study its V-I characteristics.
8. To study PAM PWM and PPM.
9. **REVERSING AN ARRAY:** A Block of 16 bytes are residing at locations starting from BLOCK 1 WAP to transfer the block in reverse order at locations starting from BLOCK 2.
10. **SORTING IN ASCENDING ORDER:** A block (16 bytes are residing at locations starting from DATA: Write a program to arrange the word in the same location in ascending order
11. **BINARY ADDITION:** 16 bytes are residing at location starting from DATA WAP: to add all bytes and store the result location SUM and SUM + 1
12. **BCD ADDITION:** 16 BCD NUMBER are residing at location starting from DATA WAP to add all bytes and store the result location SUM and SUM + 1
13. **MULTIPLICATION:** Two bytes are residing at location DATA 1 and DATA 2 Write a program to multiply the two bytes and store the result at location PROD 1 and PROD 2 .
14. **BINARY TO BCD:** A binary number is residing at location BIN > WAP to convert the binary number in to its equivalent BCD and store the result at BCD and BCD + 1
15. **PARITY CHECK:** A block of 32 bytes is residing at DATA count the number (BCD) of times even and odd PARITY bytes are appearing consecutive memory locations. Keep the count at MATCH.

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Biomedical Equipment lab	Subject code	BM20522BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	50	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
		3	2

LIST OF EXPERIMENTS

Lab activity 1. To study the operation and troubleshooting of Defibrillator

Lab activity 2.To study the operation and troubleshooting of Infusion pump and syringe pump

Lab activity 3.To study the operation and troubleshooting Pacemaker using pacemaker analyzer

Lab activity 4. To study the operation and troubleshooting Electrosurgical unit

Lab activity 5. To study the operation and troubleshooting Heart lung machine

Lab activity 6. To study the operation and troubleshooting of Heamodilazer

Lab activity 7. To study the operation and troubleshooting Ultrasound machine

Lab activity 8. To study the operation and troubleshooting X-Ray

Lab activity 9. To study the operation and troubleshooting of Computed tomography

Lab activity 10. To study the operation and troubleshooting of MRI

Lab activity 12. To study the operation and troubleshooting of Safety Evaluation Circuits

Lab activity 13. To study the operation and troubleshooting of Audiometer

Lab activity 14. To study the operation and troubleshooting of Patient monitor

Lab activity 15. To study the operation and troubleshooting of Pulse oximeter

Lab activity 16. To study the operation and troubleshooting of PET scan

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DEPARTMENT OF BIOMEDICAL ENGINEERING SYLLABUS

Name of the subject	Microelectronics and integrated circuits lab	Subject code	BM20523BM
Semester	fifth	Board of Studies	Biomedical Engg
Maximum Marks	50	Minimum Marks	
Lecture Periods/Week	Tutorial Periods/Week	Practical Periods/Week	Credits
		3	2

LIST OF EXPERIMENTS

1. Measurement of i/p resistance and o/p resistance of practical Op-Amp.
2. Measurement of the i/p offset current of practical Op-Amp.
3. Measurement of the i/p offset voltage of practical Op-Amp.
4. Measurement of the Gain-Bandwidth product of practical Op-Amp.
5. To determine SVRR (PSRR) and slew rate of an op-amp (741).
6. To design a differential amplifier using op-amp (741) and find it's CMRR.
7. To design a summing amplifier using op-amp (741).
8. To design a non-inverting amplifier using op-amp (741) and study its frequency response.
9. To design an inverting amplifier using op-amp (741) and study its frequency response.
10. Design and verify gain and frequency response of Integrator circuit using Op-Amp IC 741.
11. Design and verify gain and frequency response of Differentiator circuit using IC741.
12. To study Schmitt trigger circuit using op-amp 741.
13. To construct an astablemultivibrator using operational amplifier 741 for getting square wave and to determine the frequency of oscillation and comparing it with that of theoretical value.
14. To design and study comparator circuit using op-amp (741).
15. Design a Butter worth filter(Low Pass/High Pass/ Band Pass) using Op-Amp and study its frequency response.
16. To design and plot frequency response of a second order low pass filter using 741 Op-Amp. To measure the cut off frequency in each case and verify the theoretical value.
17. Perform the following application of PLL :
    a. As frequency synthesis
    b. As frequency multiplier
    c. FM Demodulation
    d. AM demodulation