Biomedical Engineering Programme

A proposal submitted to PDPM Indian Institute of Information Technology Design and manufacturing (PDPM IIITDM), Jabalpur India for creation of a new Programme "Biomedical Engineering Programme"

Proposal Submitted

by

Faculty Members:

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INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DESIGN AND MANUFACTURING (PDPM IIITDM) JABALPUR MADHYA PRADESH INDIA, SEPTEMBER 2014

Proposal: Creation of "Biomedical Engineering Programme" at PDPM IIITDM Jabalpur

Vision: The focus of the programme is to create future leaders in the field of the Biomedical Engineering & Technology. We represent the programme as the combination of two wings of engineering: "analysis" and "synthesis". The "analysis" provides the development of different technologies which can be further used for benefit of human being ranging from renewable energy sector, algal bio-reactor, waste water treatment, bio fuel, medical applications and ecology control etc. This "analysis" can be further used in "synthesis" of different valuable materials/products.

Members:

Dr. Manish Kumar Bajpai	CSE
Dr. Manoj Kumar Panda	Mathematics
Dr. Varun Bajaj	ECE
Dr. M. Z. Ansari	ME
Dr. Nihar Ranjan Jena	Physics

Programme proposed:

Programme	Duration
Master of Technology (M.Tech.)	02 years
Doctor of Philosophy (PhD)	03 years

Proposed Intake:

Master of Technology (15= 8 UR + 4 OBC + 2 SC + 1 ST)

Doctor of Philosophy (5)

Eligibility:

M.Tech: B.Tech. (Computer Science & Engineering, Electronics & Communication Engineering, Mechanical Engineering, Instrumentation Engineering, Biomedical Engineering, Biological Science and biological engineering) or M.Sc. (Mathematics, Physics, Chemistry and Life Sciences) or B. Pharma.

PhD: M.Tech. (Computer Science & Engineering, Electronics & Communication Engineering, Mechanical Engineering, Instrumentation Engineering, Biomedical Engineering, Biological Science and biological engineering) or M.Sc. (Mathematics, Physics, Chemistry and Life Sciences) or M. Pharma.

PDPM
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY,
DESIGN & MANUFACTURING JABALPUR

BIOMEDICAL ENGINEERING PROGRAMME

PG CURRICULUM

The academic load and the credit for a given course are decided by the following calculation:

Academic Load: **AL** = 3.0 x **L** + 1.0 x **T** + 1.5 x **P** + 0.0 x **D**

(**L**: Lecture Hours, **T**: Tutorial Hours, **P**: Practice Hours, and **D**: Discussion Hours)

Proposed Table

Academic Load **AL**	Course Weightage or **Units**
≤ 06	2
> 06 - ≤ 08 / (06, 08]	3
(08, 11]	4
(11, 13]	5
>13	6

Grading

A+ = 10, A = 9.0, B+ = 8.0, B = 7.0, C+ = 6.0,

C = 5.0, D+ = 4.0, D = 3.0, F = 2

S=Satisfactory X=Non-Satisfactory, I=Incomplete

Summary of Courses and Credits (M.Tech.)

Semester I (14 Hours/week)	**Credits: 18**
Professional and communication skills	2 (2L)
Mathematics for Biologists	4 (3L)
Biomedical Instrumentation	4 (2L+1P)
Professional Elective I	4 (3L)
Biotechnology for engineers	4 (3L)
Semester II (12 Hrs/week)	**Credits: 16**
Mathematical Modelling for biomedical Applications	4 (3L)
Open Elective I	4 (3L)
Biomedical image and signal processing	4 (2L+1P)
Professional Elective II	4 (3L)
Semester III (12 Hrs/week)	**Credits: 16**
Thesis	16
Semester IV (12 Hrs/week)	**Credits: 16**
Thesis	16

Summary of Courses and Credits (PhD)

Semester I (14 Hours/week)	**Credits: 18**
Mathematics for Biologists	4
Elective I	4
Biomedical image and signal processing	4
Elective II	4
Professional and communication skills	2
Semester II (12 Hrs/week)	**Credits: 16**
Thesis	16
Semester III (12 Hrs/week)	**Credits: 16**
Thesis	16
Semester IV (12 Hrs/week)	**Credits: 16**
Thesis	16
Semester V (12 Hrs/week)	**Credits: 16**
Thesis	16
Semester VI (12 Hrs/week)	**Credits: 16**
Thesis	16

List of Electives:

- Bio Sensors
- Molecular Bio Physics
- Advance Medical Imaging
- Advance Pattern recognition
- Bio MEMS
- Biomechanics

Course content

1. Biosensors
Overview Of Biosensors; Transducer Fundamentals; Bioreceptor Molecules; Biosensor Fundamentals; Mechanical Detectors; Electrochemical Detectors; Optical-Based Detectors; Indirect Detectors
Text book: various

2. BioMEMS
Introduction to BioMEMS; Silicon Microfabrication; "Soft" Fabrication and Polymers; Polymer Materials; Microfluidic Principles; Sensor Principles and Microsensors; Microactuators and Drug Delivery; Intro to Clinical Laboratory Medicine; Micro Total Analysis Systems (μTAS); Detection and Measurement Methods; Emerging BioMEMS Technologies; Packaging, Power, Data and RF Safety; Biocompatibility
Text Book: Fundamentals of BioMEMS and Medical Microdevices by SS Saliterman, SPIE 2006

3. Biomechanics
Mechanics of Hard Tissue; Musculoskeletal Soft Tissue Mechanics; Joint-Articulating Surface Motion; Joint Lubrication; Biomechanics of Chest and Abdomen Impact; Cardiac Biomechanics; Mechanics of Blood Vessels; Exercise Physiology; Factors Affecting Mechanical Work in Humans
Text Book: Biomechanics: Principles and Applications by DR Peterson and JD Bronzino

4. Mathematical modeling for biomedical engineering

Elementary mathematical models; Role of mathematics in problem solving; Concepts of mathematical modelling; System approach; formulation, Analyses of models; Sensitivity analysis, Simulation approach; Pitfalls in modelling, Illustrations

5. Mathematics for Biologists

Properties of Vector Algebra, Vector space, subspace, basis, null and range space, invertibility and matrix representation; Cartesian Tensor notation and vector analysis; Matrices and Matrix algebra, Echelon form, orthogonalization; Eigen values and eigenvectors of a linear operator; First and second order ODEs, Linear Differential equations with constant coefficients and equidimensional equations; Second order linear homogenous differential equations and their solutions; Methods of Taylor and Frobenius, Laplace and Fourier transforms, Fourier series; Legendre and Bessel functions; Sturm Louville Problem; classification of PDEs; Analytical solution of linear PDEs

6. Advance Medical Imaging

Overview, medical imaging, nondestructive testing, radiographic techniques, various applications, data collection, design of CT scanners for materials testing, flow measurement, related instrumentation, Radon's inversion formula, central- slice theorem, fan-beam inversion, filter functions, convolving functions transform methods, series-expansion methods, convolution algorithms, error estimates, direct theorems, inverse theorems.

Dr. Manish Kumar Bajpai: is currently working as Assistant Professor in Computer Science & Engineering (CSE) Discipline at PDPM Indian Institute of Information Technology, Design and Manufacturing Jabalpur (PDPM IIITDM Jabalpur), Jabalpur, India. He received his Doctoral degree from Indian Institute of Technology Kanpur, India in 2013. He is currently working in areas of High Performance Computing, Image Reconstruction, Medical Imaging and Climate Change. `http://www.iiitdmj.ac.in/mkbajpai.php`

Dr. Manoj Kumar Panda: received the Ph.D. degree in Mathematics from Indian Institute of Technology Kanpur, India, in 2011. He was a Postdoctoral Fellow at the Indian Institute of Science Bangalore, India from 2011-13. Currently, he is working as an Assistant Professor in Mathematics (Natural Sciences (NS) Discipline) at PDPM Indian Institute of Information Technology Design and Manufacturing Jabalpur India since 2013. His main research interests concern Bio-fluid Mechanics (bioconvection) and CFD. `http://www.iiitdmj.ac.in/mkpanda.php`

Dr. Varun Bajaj: received the Ph.D. degree in Electrical Engineering from Indian Institute of Technology Indore, India, in 2014. Presently, he is working as Assistant Professor in Electronics and Communication Engineering (ECE) Discipline, at PDPM Indian Institute of Information Technology, design and Manufacturing Jabalpur India. His research interests include biomedical signal processing, image Processing and time-frequency analysis, and neuroscience. `http://www.iiitdmj.ac.in/varunb.php`

Dr. M. Z. Ansari: received the Ph.D. degree in Mechanical Engineering from Inha University, Incheon, South Korea in 2010. Then, he worked as an Assistant Professor in Mechanical Engineering at Inha University, Incheon, Korea from 2010-13. Currently, he is working as an Assistant Professor in Mechanical Engineering (ME) at PDPM Indian Institute of Information Technology Design and Manufacturing Jabalpur India since 2014. His main research interests concern Biosensors and Finite Element Methods. `http://www.iiitdmj.ac.in/zahid.php`

Dr. Nihar Ranjan Jena: received PhD degree from Banaras Hindu University (BHU), India in 2006. Then, he did Postdoctoral from National Taiwan Normal University, Taipei, Taiwan and Hebrew University of Jerusalem, Jerusalem, Israel. After that, he worked as Guest Scientist in German Cancer Research Center (DKFZ), Heidelberg, Germany and Molecular Biophysics Unit, Indian Institute of Science, Bangalore, India. Currently, he is working as an Assistant Professor in Physics (Natural Sciences (NS) Discipline) at PDPM Indian Institute of Information Technology Design and Manufacturing Jabalpur India. `http://www.iiitdmj.ac.in/nrjena.php`