NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering in Biomedical

DEPARTMENTAL OUTCOME BASED EDUCATION (OBE) CATALOGUE

Batch 2025 and onwards

Contents

1. Vision Statement

a. University Vision

Be a leader in enabling Pakistan's social and economic transformation.

b. Department Vision

To be a leader in disseminating insightful knowledge and facilitating distinguished research in the field.

2. Mission Statement

a. University Mission

Acquire education and research excellence in engineering and allied disciplines to produce leadership and enabling application of knowledge and skills for the benefit of the society with integrity and wisdom.

b. **Programme Mission**

To produce graduates able to strengthen the Biomedical Engineering and allied sciences through a combination of educational, professional, and ethical values, and driving innovation by taking leadership roles in academia and industry.

3. Program Educational Objectives (PEOs)

PEO-1: Knowledge and skills to analyze problems and provide solutions aimed at improving the quality of life using state-of-the-art technology.

PEO-2: Leadership and interpersonal skills with ethical values for industrial and academic growth.

PEO-3: Dynamism to enhance careers by embarking on a lifelong journey of expanding knowledge, bringing about global sustainability along with societal impact.

4. Mapping of PEOs to University and Departmental Vision and Mission

Vision and Mission		Program Educational Objectives (PEOs)		
		PEO-1	PEO-2	PEO-3
University Vision	Be a leader[2] in enabling Pakistan's social[3] and economic transformation[1].	✓	✓	✓
University Mission	Acquire education and research excellence in engineering and allied disciplines to produce leadership[2] and enabling application of knowledge and skills[1] for the benefit of the society[3] with integrity and wisdom.	✓	✓	✓
Department's Vision	To be a leader[2] in disseminating insightful knowledge[1] and facilitating distinguished research in the field[3].	✓	✓	✓
Programme's Mission	To produce graduates able to strengthen the Biomedical Engineering[1] and allied sciences through a combination of educational, professional, and ethical values, and driving innovation by taking leadership[2] roles in academia and industry[3].	✓	✓	✓

5. Knowledge and Attitude (WKs) Profiles

To foster cognitive, psychomotor, and affective development in mathematical, computational, design, and creative thinking, the curriculum incorporates nine knowledge and attitude profiles (WKs) that define the expected learning volume and graduate performance standards.

- **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

- **WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling; applicable to the discipline.

- **WK3:** A systematic, theory-based formulation of engineering fundamentals required in the relevant engineering discipline.

- **WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

- **WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

- **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

- **WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development (Represented by the 17 UN Sustainable Development Goals (UN-SDG)

- **WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

- **WK9:** Ethics, inclusive behavior and conduct; Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc. with mutual understanding and respect, and of inclusive attitudes.

6. Program Learning Outcomes (PLOs)

The following graduate attributes as defined by PEC, have been adopted as Program Learning Outcomes (PLOs) by the department.

1. **PLO-1 Engineering Knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and Engineering specialization to the solution of complex engineering problems. (WK1-WK4)

2. **PLO-2 Problem Analysis:** Identify, formulate, conduct research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (WK1-WK4)

3. **PLO-3 Design/Development of Solutions:** An ability to design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (WK-5)

4. **PLO-4 Investigation:** Conduct investigation of complex Engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. (WK-8)

5. **PLO-5 Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex Engineering problems, with an understanding of the limitations. (WK-2 and WK-6)

6. **PLO-6 The Engineer and the World:** Analyze and evaluate sustainable development impacts to society, the economy, sustainability, health and safety, legal frameworks, and the environment while solving complex engineering problems. (WK-1, WK-5, and WK-7)

7. **PLO-7 Ethics:** Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion. (WK-9)

8. **PLO-8 Individual and Collaborative Team Work:** Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings. (WK-9)

9. **PLO-9 Communication:** Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, and make effective presentations, taking into account cultural, language, and learning differences. (WK-1 and WK-9)

10. **PLO-10 Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments. (WK-2 and WK-5)

11. **PLO-11 Lifelong Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK-8 and WK-9)

7. Mapping of PLOs to PEOs

Program Learning Outcomes (PLOs)	Program Educational Objectives (PEOs)		
	PEO-1	PEO-2	PEO-3
PLO 1: Engineering Knowledge	✓		
PLO 2: Problem Analysis	✓		
PLO 3: Design / Development of solutions	✓		
PLO 4: Investigation			✓
PLO 5: Tool Usage	✓		
PLO 6: The Engineer and the World			✓
PLO 7: Ethics		✓	
PLO 8: Individual and Collaborative Team Work		✓	
PLO 9: Communication		✓	
PLO 10: Project Management and Finance		✓	
PLO 11: Lifelong Learning			✓

8. Professional Competence (ECs) Profiles

Engineering Competencies (ECs) are expected to be demonstrated by graduates during their practical experiences, which have been mapped with PLOs to reflect integration in the designed curriculum.

- **EC1 Comprehend and Apply Universal Knowledge:** Comprehend and apply advanced Engineering knowledge of the widely-applied principles underpinning good practices.
- **EC2 Comprehend and Apply Local Knowledge:** Comprehend and apply advanced Engineering knowledge of the widely-applied principles underpinning good practice specific to the jurisdiction of practices.
- **EC3 Problem Analysis:** Define, investigate and analyze complex Engineering problems using data and information technologies where applicable.
- **EC4 Design and Development of Solutions:** Design or develop solutions to complex Engineering problems considering a variety of perspectives and taking account of stakeholder views.
- **EC5 Evaluation:** Evaluate the outcomes and impacts of complex Engineering activities.
- **EC6 Protection of Society:** Recognize the foreseeable economic, social, and environmental effects of complex Engineering activities and seek to achieve sustainable outcomes.
- **EC7 Legal, Regulatory, and Cultural:** Meet all legal, regulatory, and cultural requirements and protect public health and safety in the course of all Engineering activities.
- **EC8 Ethics:** Conduct Engineering activities ethically.
- **EC9 Manage Engineering Activities:** Manage part or all of one or more complex Engineering activities.
- **EC10 Communication and Collaboration:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders in the course of all Engineering activities.
- **EC11 Continuing Professional Development (CPD) and Lifelong Learning:** Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.
- **EC12 Judgment:** Recognize complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of all complex Engineering activities.
- **EC13 Responsibility for Decisions:** Be responsible for making decisions on part or all of complex Engineering activities.

9. Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are a set of 17 interlinked global goals established by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. They are designed to be a blueprint to achieve a better and more sustainable future for all by addressing various global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice.

- **SDG 1 No Poverty:** End poverty in all its forms everywhere.
- **SDG 2 Zero Hunger:** End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
- **SDG 3 Good Health and Well-being:** Ensure healthy lives and promote well-being for all at all ages.
- **SDG 4 Quality Education:** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- **SDG 5 Gender Equality:** Achieve gender equality and empower all women and girls.
- **SDG 6 Clean Water and Sanitation:** Ensure availability and sustainable management of water and sanitation for all.
- **SDG 7 Affordable and Clean Energy:** Ensure access to affordable, reliable, sustainable, and modern energy for all.
- **SDG 8 Decent Work and Economic Growth:** Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
- **SDG 9 Industry, Innovation, and Infrastructure:** Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
- **SDG 10 Reduced Inequalities:** Reduce inequality within and among countries.
- **SDG 11 Sustainable Cities and Communities:** Make cities and human settlements inclusive, safe, resilient, and sustainable.
- **SDG 12 Responsible Consumption and Production:** Ensure sustainable consumption and production patterns.
- **SDG 13 Climate Action:** Take urgent action to combat climate change and its impacts.
- **SDG 14 Life below Water:** Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
- **SDG 15 Life on Land:** Protect, restore, and promote sustainable use of terrestrial ecosystems, manage forests sustainably, combat desertification, halt and reverse land degradation, and halt biodiversity loss.
- **SDG 16 Peace, Justice, and Strong Institutions:** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.
- **SDG 17 Partnerships for the Goals:** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

10. Mapping of Bachelors of Engineering Program with UN SDGs

Description	UN SDGs																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
University vision and mission	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bachelor of Engineering Curriculum (Engg. and Non-Engg. Courses)			✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	
Final Year Design Project (FYDP)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
Other pre-requisite activities (Internship, Community service, Survey camp, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Co- and Extra-Curricular Activities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

11. Correlation Matrix PLOs-ECs-WKs-SDGs

A correlation matrix has been established to link Program Learning Outcomes (PLOs) with the corresponding engineering competencies (ECs), knowledge and attitude profiles (WKs), as well as the targeted UN Sustainable Development Goals (SDGs) by 2030.

PLOs	ECs	WKs	SDGs
PLO-1 Engineering Knowledge	EC-1 Comprehend and apply universal knowledge EC-2 Comprehend and apply local knowledge	WK-1 Natural sciences and awareness of relevant social sciences WK-2 Mathematics & computing WK-3 Engineering fundamentals WK-4 Engineering specialist knowledge	SDG-9
PLO-2 Problem Analysis	EC-3 Problem analysis	WK-1 Natural sciences and awareness of relevant social sciences WK-2 Mathematics & computing WK-3 Engineering fundamentals WK-4 Engineering specialist knowledge	Selected SDGs from SDG - 1 to 17 (relevance as per curriculum)
PLO-3 Design/ Development of Solutions	EC-4 Design and development of solutions	WK-5 Engineering design and operations	SDG-1, 2, 3, 6, 9, 10, 11, 12, 13, 14 (relevance as per curriculum)
PLO-4 Investigation	EC-5 Evaluation	WK-8 Research literature	SDG-9
PLO-5 Tool Usage	EC-3 Problem analysis EC-5 Evaluation	WK-2 Mathematics & computing WK-6 Engineering practice	SDG-9

PLO-6 The Engineer and the World	EC-6 Protection of society EC-7 Legal, regulatory, and cultural	WK1 Natural sciences and awareness of relevant social sciences WK-5 Engineering design and operations WK7 Engineering in Society	Selected SDGs from SDG - 1 to 17 (relevance as per curriculum)
PLO-7 Ethics	EC-8 Ethics	WK-9 Ethics, inclusive behavior and conduct	SDG-5 SDG-10 SDG-16
PLO-8 Individual and Collaborative Team work	EC-10 Communication and Collaboration	WK-9 Ethics, inclusive behavior and conduct	SDG-5 SDG-10 SDG-16
PLO-9 Communication	EC-10 Communication and Collaboration	WK-1 Natural sciences and awareness of relevant social sciences WK-9 Ethics, inclusive behavior and conduct.	SDG-5 SDG-10 SDG-16
PLO-10 Project Management and Finance	EC-9 Manage engineering activities	WK-2 Mathematics & computing WK-5 Engineering design and operations	SDG-9 SDG-10
PLO-11 Lifelong Learning	EC-11 Continuing Professional Development (CPD) and lifelong learning EC-12 Judgment EC-13 Responsibility for decisions	WK-8 Research literature	SDG-3 SDG-4 SDG-8 SDG-9 SDG-12 SDG-13

12. Curriculum Design

Knowledge Profile (WK-1 to WK-9)	Knowledge Area	Sub-Area	Courses	Credit Hours
General Education / Non-Engineering Domain				
WK-1 / WK-2	Natural Sciences	Mathematics	1. MT-116 Calculus & Analytical Geometry (3+0) 2. MT-221 Linear Algebra & Ordinary Differential Equations (3+0) 3. BM-312 Biostatistics (2+1) 4. BM-401 Numerical Methods for Biomedical Engineering (3+0)	12
		Physics	5. PH-129 Applied Physics (3+0)	3
		Chemistry	6. CY-100 Essentials of Chemistry (NC)	0
		Natural Science / Math Elective		
WK-1 / WK-5 / WK-7 / WK-9	Humanities	English	7. EA-128 Functional English (3+0) 8. EA-244 Academic Reading and Writing (3+0)	6
		Culture	9. ES-105/ ES-127 Pakistan Studies / Pakistan Studies (for Foreigners) (2+0) 10. ES-206/ES-209 Islamic Studies / Ethical Behaviour (for Non-Muslims) (2+0) 11. ES-108 Ideology and Constitution of Pakistan (2+0) 12. EA/ES- ### Foreign Language-I (NC) 13. EA/ES- ### Foreign Language-II (NC)	6
		Social Science	14. EF-201 Civics and Community Engagement (2+0) 15. MG-257 Organizational behaviour (2+0) 16. EF-200 Community Service (NC)	4
	Management Sciences	Professional Practice	17. BM-314 Project Management (2+0)	4

			18. MG-485 Entrepreneurship (2+0)	
	Computer Sciences	Basic Computing	19. EF-101 IT Fundamentals & Applications (2+1)	3
Total Credit Hours for General Education / Non-Engineering Domain:				38
Engineering Domain				
WK-2 / WK-4 / WK-5	Advanced Computer and Information Science	ICT / AI / Data Science / Cyber Security	20. CS-109 Computer Programming (2+1) 21. BM-316 Artificial Intelligence in Healthcare (2+1)	6
WK-2 / WK-3	Foundation Engineering Courses		22. BM-131/ MT-103 Introduction to Biology / Introduction to Mathematics (2/3+1/0) 23. BM-133 Foundation of Biomedical Engineering (3+1) 24. EE-125 Basic Electrical Engineering (3+1) 25. BM-114 Anatomy (3+1) 26. EE-217 Circuit Theory (2+0) 27. BM-209 Basic Electronics (3+1) 28. BM-230 Biochemistry (2+1) 29. BM-232 Human Physiology (3+1)	28
WK-1 / WK-2 / WK-4	Core Breadth of Engineering Disciplines		30. BM-130 Computer Aided Engineering Graphics (1+1) 31. TC-205 Digital Logic Design (3+1) 32. BM-208 Biomedical Electronics (3+1) 33. CS-354 Microprocessor Programming and Interfacing (2+1) 34. BM-306 Bioinstrumentation & Measurements-I (3+1) 35. BM-311 Bioinstrumentation & Measurements-II (3+1) 36. EE-493 Digital Signal Processing (3+1)	25
WK-5 / WK-6	Core Depth of Engineering Disciplines		37. BM-315 Biomechanics (3+1) 38. BM-313 Biomaterials (3+1) 39. BM-406 Biomedical Imaging (2+1) 40. BM-451 Biosignal Processing (2+1)	26

			41. BM-### Elective 1 (2+1) 42. BM-### Elective 2 (3+0) 43. BM-### Elective 3 (2+1) 44. BM-### Elective 4 (3+0)	
WK-1 / WK-2 / WK-3 / WK-4 / WK-7 / WK-9	Multi-disciplinary Engineering Courses		45. EF-309 Occupational Safety & Health (1+0) 46. BM-310 Control Systems for Biomedical Engineers (2+1) 47. BM-452 Modelling and Simulation for Biomedical Engineers (2+1)	7
WK-4 / WK-5 / WK-6 / WK-7 / WK-8 / WK-9	Final Year Design Project (FYDP)	48. Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year. (6+0)		6
WK-6 / WK-7 / WK-9	Industrial Training	Internship (06-08 Weeks)		0
WK-2 / WK-4 / WK-5 / WK-6 / WK-7 / WK-8	Innovative and Critical Thinking (under relevant courses): ▪ Complex Problem Solving ▪ Complex Engineering Activities ▪ Design Project ▪ Case Studies ▪ Open Ended Labs ▪ Problem Based Learning			
			Total Credit Hours for the Engineering Domian:	98
			Total Credit Hours for the Curriculum:	136

13. Scheme of Studies

Biomedical Engineering

First Year

Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
BM-131/ MT-103	Introduction to Biology / Introduction to Mathematics	2/3	1/0	3	BM-133	Foundation of Biomedical Engineering	3	1	4
EF-101	IT Fundamentals & Applications	2	1	3	CS-109	Computer Programming	2	1	3
ES-105/ ES-127	Pakistan Studies / Pakistan Studies (for Foreigners)	2	0	2	MT-116	Calculus & Analytical Geometry	3	0	3
ES-206/ ES-209	Islamic Studies / Ethical Behaviour (for Non-Muslims)	2	0	2	EE-125	Basic Electrical Engineering	3	1	4
PH-129	Applied Physics	3	0	3	ES-108	Ideology and Constitution of Pakistan	2	0	2
EA-128	Functional English	3	0	3					
CY-100	Essentials of Chemistry+	-	-	NC					
Total		**15/14**	**1/2**	**16**	**Total**		**13**	**3**	**16**

Second Year

Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
BM-114	Anatomy	3	1	4	BM-232	Human Physiology	3	1	4
BM-209	Basic Electronics	3	1	4	BM-208	Biomedical Electronics	3	1	4
EF-201	Civics and Community Engagement	2	0	2	BM-130	Computer Aided Engineering Graphics	1	1	2
BM-230	Biochemistry	2	1	3	TC-205	Digital Logic Design	3	1	4
MT-221	Linear Algebra & Ordinary Differential Equations	3	0	3	EF-309	Occupational Safety & Health	1	0	1
EE-217	Circuit Theory	2	0	2	EA-244	Academic Reading and Writing	3	0	3
					EF-200	Community Service	-	-	NC
Total		**15**	**3**	**18**	**Total**		**14**	**4**	**18**

Third Year

Fall Semester					Spring Semester				
Course Code	Course Title	Credit Hours			Course Code	Course Title	Credit Hours		
		Th	Pr	Total			Th	Pr	Total
BM-306	Bioinstrumentation & Measurements-I	3	1	4	BM-313	Biomaterials	3	1	4
BM-314	Project Management	2	0	2	BM-310	Control Systems for Biomedical Engineers	2	1	3
BM-315	Biomechanics	3	1	4	BM-311	Bioinstrumentation & Measurements-II	3	1	4
BM-312	Biostatistics	2	1	3	BM-316	Artificial Intelligence in Healthcare	2	1	3
CS-354	Microprocessor Programming and Interfacing	2	1	3	EE-493	Digital Signal Processing	3	1	4
					EA/ES-###	Foreign Language-I	-	-	NC
Total		**12**	**4**	**16**	**Total**		**13**	**5**	**18**

Fourth Year									
Fall Semester					**Spring Semester**				
Course Code	**Course Title**	**Credit Hours**			**Course Code**	**Course Title**	**Credit Hours**		
		Th	**Pr**	**Total**			**Th**	**Pr**	**Total**
BM-###	Elective 1	2	1	3	BM-###	Elective 3	2	1	3
BM-451	Biosignal Processing	2	1	3	BM-413	Biomedical Engineering Design Project	0	3	3
BM-406	Biomedical Imaging	2	1	3	BM-###	Elective 4	3	0	3
BM-401	Numerical Methods for Biomedical Engineering	3	0	3	BM-452	Modelling and Simulation for Biomedical Engineers	2	1	3
BM-413	Biomedical Engineering Design Project*	0	3	3	MG-257	Organizational behaviour	2	0	2
BM-###	Elective 2	3	0	3	MG-485	Entrepreneurship	2	0	2
EA/ES-###	Foreign Language-II	-	-	NC					
Total		**12**	**6**	**18**	**Total**		**11**	**5**	**16**

+ Only for students with computer science background
** Duration one academic year: Requires literature survey and preliminary work during this Semester*

ELECTIVE COURSES									
Elective 1 & 3 (2+1)					**Elective 2 & 4 (3+0)**				
Course Code	**Course Title**	**Credit Hours**			**Course Code**	**Course Title**	**Credit Hours**		
		Th	**Pr**	**Total**			**Th**	**Pr**	**Total**
BM-422	Biotechnology	2	1	3	BM-436	Digital Transformation	3	0	3
BM-423	Introduction to Robotics	2	1	3	BM-437	Computer Aided Diagnostics	3	0	3
BM-429	Tissue Engineering	2	1	3	BM-421	Genetic Engineering	3	0	3
BM-430	Rehabilitation Engineering	2	1	3	BM-424	Fluid Dynamics	3	0	3
BM-432	Neuroscience & Neural Networks	2	1	3	BM-425	Telemedicine	3	0	3
BM-307	Bioinformatics	2	1	3	BM-435	Biophysics	3	0	3
					BM-426	Ergonomics	3	0	3
					BM-427	Product Design in Biomedical Engineering	3	0	3
					BM-431	Biophotonics	3	0	3

Foreign Language-I & Foreign Language-II (Non-Credit)

Foreign Language-I Courses		Foreign Language-II Courses	
EA-220	Chinese Language – I (CL-I)	EA-221	Chinese Language – II (CL-II)
EA-224	German Language – I (GL-I)	EA-225	German Language – II (GL-II)
EA-226	French Language – I (FL-1)	EA-227	French Language – II (FL-II)
EA-231	Turkish Language – I (TL-I)	EA-232	Turkish Language – II (TL-II)
ES-222	Arabic Language – I (AL-I)	ES-223	Arabic Language – II (AL-II)
EA-233	Japanese Language – I (JL-I)	EA-234	Japanese Language – II (JL-II)
EA-235	Russian Language – I (RL-I)	EA-236	Russian Language – II (RL-II)

Total Credit hours of proposed scheme = 136

14. Mapping of Curriculum to PLOs

Biomedical Engineering Courses			Program Learning Outcomes (PLOs)										
			PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11
First Year	Fall	BM-131 Introduction to Biology / MT-103 Introduction to Mathematics	C1, C1, C1										
		EF-101 IT Fundamentals & Applications	C2				C3, C3						
		ES-105 Pakistan Studies / ES-127 Pakistan Studies (for Foreigners)						C2, C2					
		ES-206 Islamic Studies / ES-209 Ethical Behaviour (for Non-Muslims)							C2, C2				
		PH-129 Applied Physics	C2,	C3, C3									
		EA-128 Functional English									A3, C2,		C6
		CY-100 Essentials of Chemistry											
	Spring	BM-133 Foundation of Biomedical Engineering	C2, P1	C2, C3									
		CS-109 Computer Programming	C2		C3		C3						
		MT-116 Calculus & Analytical Geometry		C3, C3, C3									
		EE-125 Basic Electrical Engineering	C3	C4, P3									
		ES-108 Ideology and Constitution of Pakistan						C2, C2					
Second Year	Fall	BM-114 Anatomy	C2	C3						C4			
		BM-209 Basic Electronics	C1	C2			P2			A3			
		EF-201 Civics and Community Engagement						C2					A3
		BM-230 Biochemistry	C1			P3			C3				
		MT-221 Linear Algebra & Ordinary Differential Equations	C2	C3									
		EE-217 Circuit Theory	C2	C3									
	Spring	BM-232 Human Physiology	C2	P1		C4					C2		
		BM-208 Biomedical Electronics	C2		C5		P3						C2
		BM-130 Computer Aided Engineering Graphics	C2				P3						
		TC-205 Digital Logic Design	C3		C5		P3						
		EF-309 Occupational Safety & Health						C2					A3
		EA-244 Academic Reading and Writing									C2, C3		C6
		EF-200 Community Services						A3					A2
Third Year	Fall	BM-306 Bioinstrumentation & Measurements-I	C2		P3					A4		C5	
		BM-314 Project Management								C3		C2	
		BM-315 Biomechanics	C3	P2		C4	C5						
		BM-312 Biostatistics	C2	C2			P3	C3					
		CS-354 Microprocessor Programming and Interfacing	C3	C4			C3						

Biomedical Engineering Courses			Program Learning Outcomes (PLOs)										
			PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11
Third Year	Spring	BM-313 Biomaterials	C1		C2		P1	C3					
		BM-310 Control Systems for Biomedical Engineers	C2	C3		C5				P2			
		BM-311 Bioinstrumentation & Measurements-II	C1		C3			P2			A4		
		BM-316 Artificial Intelligence in Healthcare	C2					C4				P3	
		EE-493 Digital Signal Processing	C1		C5	C4, P3							
		Foreign Language-I											
		Internship	C	C				A	A	A	A		
Fourth Year	Fall	BM-413 Biomedical Engineering Design Project		C	C			C	A	A	A	A	
		BM-### Elective 1	C4						C2	P2			
		BM-451 Biosignal Processing	C2	P3				C3					
		BM-406 Biomedical Imaging	C2	C3		P3					A4		
		BM-401 Numerical Methods for Biomedical Engineering	C3	C4		C3							
		BM-### Elective 2	C1					C2					C2
		Foreign Language-II											
	Spring	BM-413 Biomedical Engineering Design Project		C	C				A	C, A	C, A	C	C
		BM-### Elective 3	C4						C2	P2			
		BM-### Elective 4	C1					C2					C2
		BM-452 Modelling and Simulation for Biomedical Engineers	C2			C4		A4				P2	
		MG-257 Organizational behaviour						C3					C2
		MG-485 Entrepreneurship								C3			C2
Electives	1 & 3	BM-422 Biotechnology	C4						C2	P2			
		BM-423 Introduction to Robotics	C4						C2	P2			
		BM-429 Tissue Engineering	C4						C2	P2			
		BM-430 Rehabilitation Engineering	C4						C2	P2			
		BM-432 Neuroscience & Neural Networks	C4						C2	P2			
		BM-307 Bioinformatics	C4						C2	P2			
	2 & 4	BM-436 Digital Transformation	C1					C2					C2
		BM-437 Computer Aided Diagnostics	C1					C2					C2
		BM-421 Genetic Engineering	C1					C2					C2
		BM-424 Fluid Dynamics	C1					C2					C2
		BM-425 Telemedicine	C1					C2					C2
		BM-435 Biophysics	C1					C2					C2
		BM-426 Ergonomics	C1					C2					C2
		BM-427 Product Design in Biomedical Engineering	C1					C2					C2
		BM-431 Biophotonics	C1					C2					C2

15. Key Performance Indicators (KPIs)

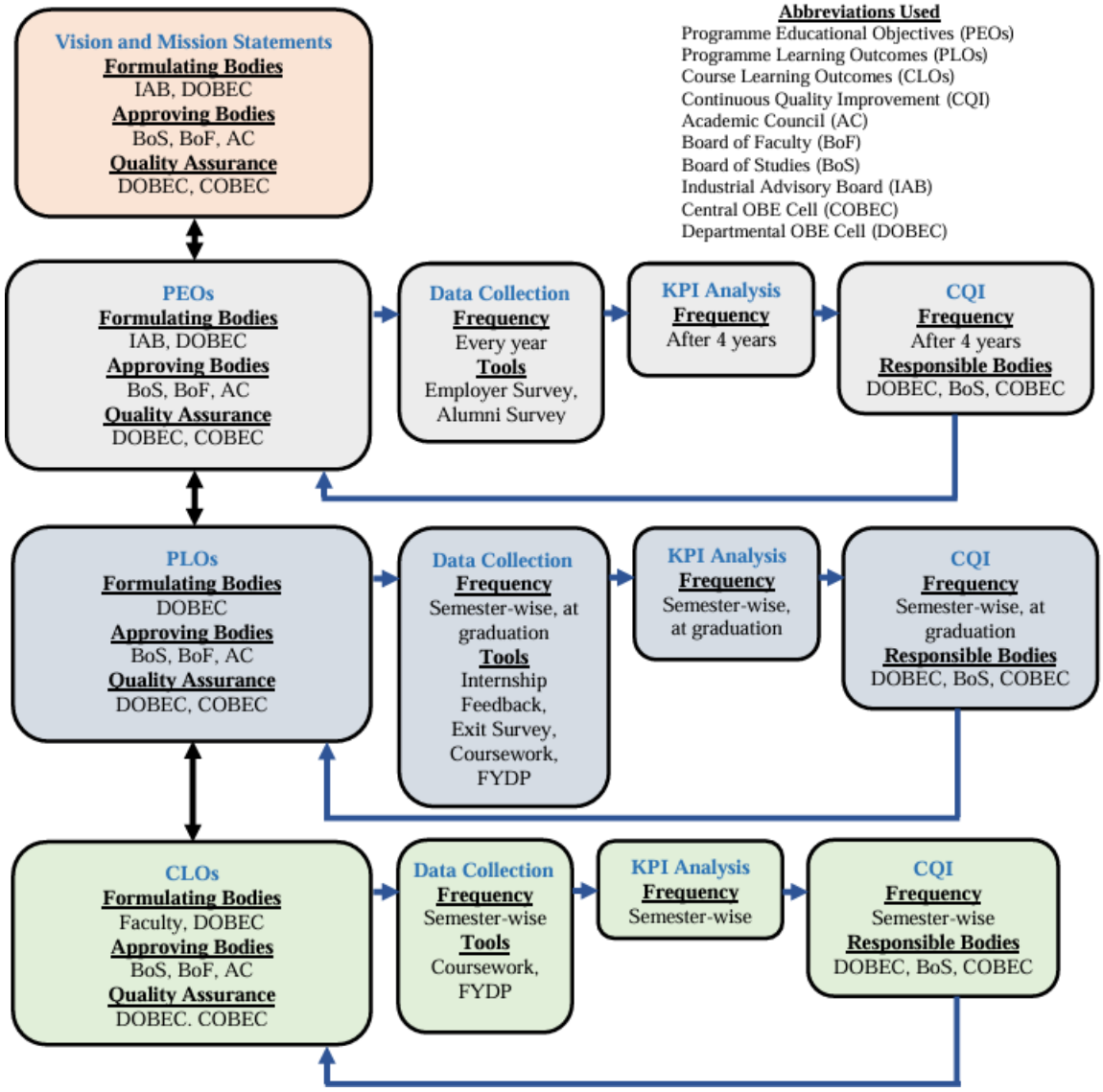
		Evaluation Tool	KPI	Data Collection Frequency	Analysis Frequency
PEO	Programme	▪ Employer Feedback Survey ▪ Alumni Feedback Survey ▪ Employment Statistics	50% of the Survey Form responses must attain a score of 3 or above on a scale of 1 to 5, and 50% of the graduates must be employed and/or engaged in higher studies.	Every Year	4 years from graduation
PLO	Student	▪ CLO scores of the student in the mapped course(s)	Each PLO must be attained in at least 50% of the respective mapped course(s), with an average score of at least 50%.	Every Semester	Every Semester
	Course	▪ PLO scores of all the students in the mapped course	At least 50% of the students must attain that PLO	Every Semester	Every Semester
	Programme	▪ Final PLO attainment statistics of all the courses including FYDP ▪ Internship Feedback Form ▪ Exit Survey	At least 50% of the mapped courses must attain the PLO and at least 50% of the students/ responses must attain a score of 3 or above on a scale of 1 to 5.	At graduation	At graduation
CLO	Student	▪ Course work	The student must obtain at least 50% average percentage score from all attempts.	Every Semester	Every Semester
	Course	▪ CLO scores of all students in the course	At least 50% of the students must attain that CLO	Every Semester	Every Semester

16. Continuous Quality Improvement (CQI)

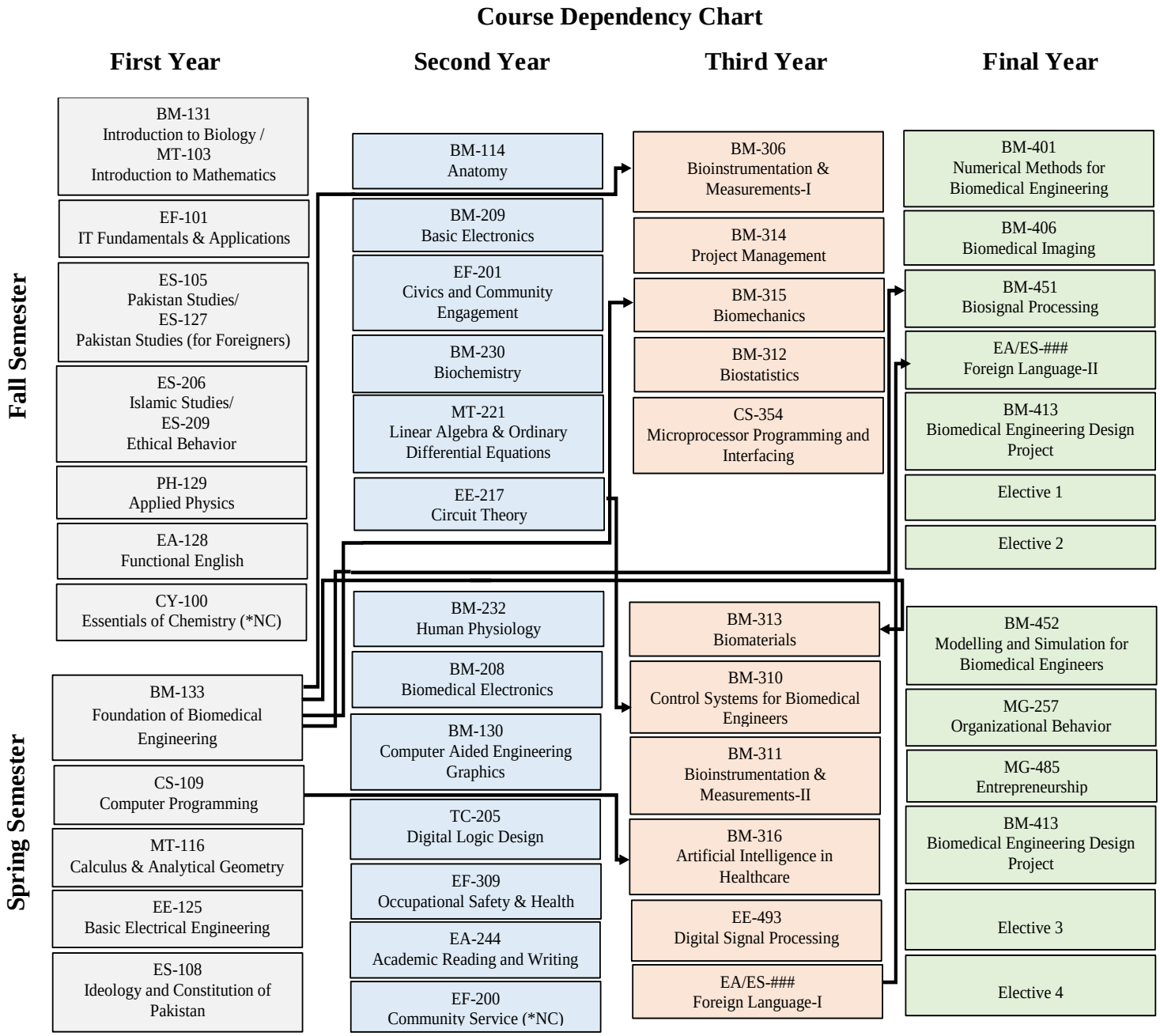
The following table shows the post KPI evaluation actions, severity-wise, as outlined in the Manual of Uniform OBE Framework.

	PEO CQI	**PLO CQI**			**CLO CQI**	
	Program KPI	**Student KPI**	**Course KPI**	**Programme KPI**	**Student KPI**	**Course KPI**
KPIs Achieved	▪ No Action	▪ No Action	▪ No Action	▪ No Action	▪ No Action	▪ No Action
KPIs Not Achieved	1. Review of curriculum strategies. 2. Review of assessment methods. 3. Review of the relevant KPIs. 4. Review of PEOs. 5. Revisions implemented.	1. Warning through the progressive attainment sheet. 2. Student counselling.	1. Review of teaching and learning process. 2. Review of CLOs assessment methods. 3. Review of CLO-PLO mapping and the relevant KPIs. 4. Review of curriculum design. 5. Revisions implemented.	1. Review of teaching and learning process. 2. Review of PLOs assessment methods. 3. Review of Course-PLO mapping and the relevant KPIs. 4. Review of curriculum design. 5. Revisions implemented.	1. Student provided further chances through direct assessment tools. 2. Student counselling.	1. Review of CLO assessment methods. 2. Review of CLOs and taxonomy levels. 3. Review of students' course feedback. 4. Review of CLO KPIs. 5. Faculty advice by Departmental OBE Cell. 6. Faculty training.

The following figure shows the overall OBE framework for an Engineering Programme as outlined in the Manual of Uniform OBE Framework.



17. Course Dependencies



18. Course Profiles

Course profiles of all the Engineering and Non-Engineering Courses as listed in the Scheme of Studies, are attached herewith

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-131 Introduction to Biology**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction to Biology

Definition; major branches of biology; levels of biological organization; application of biology in Biomedical Engineering.

Unit of Life

Cell and its organelles; chemical composition of cell; cell division; mitosis, meiosis and their significance.

Variety of Life

Needs and bases of biological classification; viruses: discovery, characteristics, structure, and classification; life cycle of bacteriophage.

The Five Kingdom System

Kingdom Prokaryote; Kingdom Protista;
Kingdom Fungi; Kingdom Plantae; Kingdom Animalia.

Nutrition

Types of nutrition; nutrition in amoeba; hydra; planaria; cockroach; nutrition in man; disorders of gastrointestinal tract of man.

Respiration

Respiratory surfaces; respiratory gases; transport of gases in animals.

Transport

Need for transport; circulatory system of man; structure of heart; cardiovascular diseases.

Homeostasis

Osmoregulation; excretion and thermoregulation; excretion in amoeba; hydra; planaria; earthworm and cockroach; excretion in man.

Support and Locomotion

Support and movement in man and animals; human skeleton; structure and muscular system in man.

Coordination and Control

Definition and need; nervous system of hydra; planaria; cockroach; chemical co-ordination.

Reproduction

Reproductive system in selected animals.

Growth, development and inheritance

Process of development; chromosomes; genes Mendel's laws of inheritance.

Theories of evolution

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Darwin's theory of Evolution; evidences of evolution**.**

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Define** basic biological concepts and life processes	C1	1
2	**Identify** common biological issues involving genetic and environmental factors.	C1	1
3	**Recognize** basic procedures and observations from biology laboratory experiments.	C1	1

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **MT-103 Introduction to Mathematics**	SEMESTER **□ SPRING ■ FALL**	CREDIT HOURS **TH □4 ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Complex Numbers

Properties of complex numbers, conjugates and modules. Geometrical representation of complex numbers.

Functions and their graph

Functions, Graph of linear and non-linear functions, Roots of a quadratic equation (real, distinct, equal and imaginary roots). Formation of quadratic equation.

Matrices

Properties of matrices, sum, difference and multiplication of matrices. Cramer's rule, solution of linear equations of three variables, determinant of a matrix, Eigen values and Eigen vectors of a matrix.

Sequence and Series

Arithmetic progression, standard forms of an A. P.; arithmetic means. Geometric progression, standard forms of a G. P., sum of Infinite geometric series, geometric means. Harmonic progression, harmonic means. Relation between H.M., A.M. and G.M, Binomial Series.

Partial Fraction

Rational function, proper fraction, improper fraction.

Trigonometric Functions and Identities

Sine, Cosine, Tangent etc. relation between them. Trigonometric identities, sum and difference formulae, multiple angle formulae, Inverse functions. Unit circle and relation between Radian and degree.

Limits

Basic concepts of limit, evaluation of limit of simple algebraic and rational function.

Differentiation

Differentiation of product and quotient formula, trigonometric functions, exponents and logarithmic functions.

Integration

Basic integrals, integrals of sum powers of trigonometric functions, exponent functions and logarithmic functions, Integration by parts and etc.

Coordinate Geometry

Basic concept of coordinate system, length, mid-point, gradient of line segment, different forms of equation of a line. Angle between two lines, distance of a point from a line.

Conic Sections:

Basic concept of intersection of cone by plan, Equation of Circle, Parabola, Ellipse and hyperbola.

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Identify** functions and sketch their graphs	C1	1
2	**Discuss** the concept of differential and integral calculus.	C1	1
3	**Describe** sum and convergence of Series.	C1	1

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EF-101 IT Fundamentals & Applications**	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Fundamentals of IT

Introduction to Information and Communication Technologies (ICT), Components and scope of ICT, ICT productivity tools, Emerging technologies and future trends, Ethical Considerations in Use of ICT Platforms and Tools, Applications of ICT in education, healthcare and finance. Digital citizenship.

Data Representation and Number Systems

Binary, octal, decimal, hexadecimal systems, data representation: characters, numbers, multimedia.

Databases

Fundamentals of databases, organization and storage, introduction to Information Systems (IS) and Management Information Systems (MIS), real world IS and MIS applications.

Data Communication and Computer Networking

Network topologies, types of network

Programming Languages

Evolution and structures: syntax, semantics, special purpose vs. general-purpose languages, comparative study of data types, control structures and algorithms, basics of coding, practical problem solving.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** fundamental concepts in information technology and data management	C2	1
2	**Apply** programming constructs to solve complex problems using a modern high-level language	C3*	5

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

3	**Practice** the application of ICT tools and computer programming in a laboratory environment	$C3^{+}$	5

REMARKS (if any):

* Also to be assessed in lab work through software rubric in addition to theory.

+ Only to be assessed in lab work through software rubric.

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **ES-105 Pakistan Studies**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **21 JUNE 2023**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-16 Peace, Justice, and Strong Institutions

COURSE CONTENTS

Historical and Ideological Perspective of Pakistan Movement

Two Nation Theory, Factors leading to the creation of Pakistan, Jinnah and demand for Pakistan.

Land of Pakistan

Geophysical conditions of Pakistan, Geopolitical and strategic importance of Pakistan, Natural resources of Pakistan: mineral, water and power resources.

Constitutional process

Early efforts to make a constitution (1947-1956), Salient features of the Constitution of 1956, 1962, Political and Constitutional crisis of 1971, Salient features of the Constitution of 1973, Constitutional amendments from 1973 to date.

Contemporary issues of Pakistan

A brief Survey of Pakistan's economy, The Current Economic Situation of Pakistan: Problems & Issues and future perspective, Social Issues: Pakistan's society and culture: broad features, Literacy and education in Pakistan: problems and issues, Scientific and technical development in Pakistan, Citizenship: national and international. Environmental Issues: Environmental pollution: causes, hazards and solutions, National policy, International treaties, conventions and protocols.

Pakistan's Foreign Policy

Pakistan's Foreign Policy from 1947 to present, Relations with immediate neighbors, Relations with major powers, Relations with the Muslim world.

Human Rights

Conceptual foundations, Western and Islamic perspective of Human Rights, Human Rights in the Constitution of 1973, Human rights issues in Pakistan.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
01	**Explain** the historical and ideological foundations of the Pakistan Movement and assess its contemporary relevance in both regional and global contexts.	C2	6
02	**Discuss** key issues related to Pakistan's natural resources, economy, governance, and climate change, and propose viable solutions to address these challenges	C2	6

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **ES-127 Pakistan Studies (For Foreigners)**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-16 Peace, Justice, and Strong Institutions

COURSE CONTENTS

Land of Pakistan

Land & People-Strategic importance- Important beautiful sights, Natural resources.

A Brief Historical Background

A brief Historical survey of Muslim community in the sub-continent, British rule & its impacts, Indian reaction, Two nation theory, Origin & development, Factors leading towards the demand of a separate Muslim state, Creation of Pakistan

Government & Politics in Pakistan

Constitution of Pakistan, A brief outline, Governmental structure, Federal & Provincial, Local Government Institutions, Political History, A brief account.

Pakistan & the Muslim World

Relations with the Muslim countries

Language and Culture

Origins of Urdu Language, Influence of Arabic & Persian on Urdu Language & Literature, A short history of Urdu literature

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** the historical, ideological, socio-economic, and political aspects of Pakistan as a nation and state.	C2	6
2	**Discuss** Pakistan's culture, issues, and challenges through appropriate actions and advocacy	C2	6

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE	SEMESTER	CREDIT HOURS
ES-206 – Islamic Studies	☐ SPRING ■ FALL	TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH**
None	**15 MAY 2024**	**2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-16 Peace, Justice, and Strong Institutions

COURSE CONTENTS

Fundamentals of Islam

Tauheed, Arguments for the Oneness of God; **Al-Ambiya-22, Al-Baqarah-163-164,** Impact of Tauheed on human life, Place of Man in the Universe: **Al Israa/Bani Israil-70**; Purpose of creation: **Al zariyat-56,** Prophethood, Need for Prophet, Characteristics of Prophet, Finality of Prophethood: **Al-Imran-79, Al-Hashr-7, Al-Maidah-3,** and Faith in Hereafter (Aakhirat), Effects on worldly life: **Al-Hajj-5, Al-Baqarah-48, Hadith**

Ibadah

Concept of Ibadah, Major Ibadah, Salat, Zakat, Hajj and Jihad. **Al-Mu'minun-1-11, Al Anfaal- 60, & Two Ahadiths**

Basic Sources of Shariah

The Holy Quran, Its revelation and compilation, the authenticity of the Text, Hadith, Its need, Authenticity and Importance, Consensus (Ijmaa), Analogy (Qiyas)

Moral and Social Philosophy of Islam

The concept of Good and Evil; **A'l e Imran - 110, Al Nahl-125,** Akhlaq-e-Hasna with special reference to **Surah Al-Hujrat, verses 10, 11, 12, 13,** Professional Ethics (Kasb-e-Halal) **Al Taha-81, Al Baqar 188, one hadith.**

Seerat of the Holy Prophet (PBUH)

a) Moral and ethical teachings of the Holy Prophet (PBUH) with special reference to Hajjat-ul-Wida, (Fundamentals of Islam, Social aspects, Economics aspects, political aspects

b). Personal Characteristics: perseverance & trust in Allah, honesty & integrity, simplicity & humility, mercy & compassion, clemency & forgiveness, bravery & valor, generosity, patience.

c) Engagement and communication with collaborators and foes:

Cases Study from Seerah: Charter of Madina, Ghazwa e Khandaq, Treaty of Hudaibya , Ghazwa e Khayber, Najran's Delegation, Victory of Makkah.

d) Social values and rights, (peace & harmony, tolerance, solidarity, collaborations, inclusivity & cohesion)

Case Studies from Seerah: Al –Fudoul Confederacy, Placement of Black stone, charter of Medina, Treaty of Hudaibya)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

leadership skills (Vision, communication, negotiation, conflict management, decision making, relationship building, Integrity, positivity, compassion, empathy, loyalty, accountability, confidence, delegation, empowerment, problem-solving, foresightedness, openness, gratitude and justice).

Teaching of Holy Quran

Translation and tafseer of **Surah-e- Fatiha**, and The Selected Section of Sura Al-Furqan verses (63-77), Surah**-e-Luqman** (verses (12-19)).

Nazraah and Tajveed of

Suratul Fatiha, Ayatal Kursi, and last 10 surahs of the Holy Quran. (Ghunnah, Qalqalah, Al-Madd, Noon Sakinah & Tanween Rules)

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the provided Quranic verses and Hadiths and their functional meaning and about the specified topics.	**C2**	**7**
2	**Describe** the foundational principles of Sariah sources and the exemplary characteristics of Seerat –un-Nabi (SAW) in personal and professional life.	**C2**	**7**

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **ES-209 Ethical Behavior (for Non-Muslims)**	SEMESTER **□SPRING ■FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-16 Peace, Justice, and Strong Institutions

COURSE CONTENTS

Nature, Scope, and Methods of Ethics

Ethics and Religion, Ethical teachings of World Religions

Basic Moral Concepts

Right and Wrong, Good and Evil

Ethical Systems in Philosophy

Hedonism, Utilitarianism, Rationalism & Kant, Self-Realization Theories, Intuitionism

Islamic Moral Theory

Ethics of Qur'an and its Philosophical basis, Ethical precepts from Qur'an and Hadith and Promotion of Moral Values in Society.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1.	**Explain** the ethical teachings of the world's major religions.	C2	7
2.	**Describe** the importance and implications of ethics on individuals and societies.	C2	7

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **PH-129 Applied Physics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-07 Affordable and Clean Energy

COURSE CONTENTS

Vectors & Mechanics

Review of vectors, Newton Laws and their Applications, Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass.

Waves and Oscillations

Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation and Resonance, Types of Waves and Superposition Principle

Optics and Lasers

Huygens Principle, Two-slit interference, Single-Slit Diffraction, Types of Lasers, Applications of Laser.

Modern Physics

Planck's explanations of Black Body Radiation Photoelectric Effect, De-Broglie Hypothesis, Electron Microscope, Atomic structure, X-rays, Radioactive Decay and Radioactive Dating, Radiation Detection Instruments

Electrostatics and Magnetism

Electric field due to different Charge Distribution, Electrostatic Potential Applications of Gauss's Law, Lorentz Force Ampere's Law, Magnetism, Magnetization, Magnetic Materials.

Electrical Elements and Circuits

Review of electric current, voltage, power, and energy, Ohm's law, inductance, capacitance, Basic Electrical circuits, Electromechanical systems.

Semiconductor Physics and Electronics:

Energy levels in a Semiconductor, Hole concept, P-N junction, Diodes, Transistors, Basic Electronic circuits (e.g. rectifier).

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Thermodynamics

Review of Laws of Thermodynamics, conduction, convection, and radiation. Thermal conductivity, specific heat, and overall heat transfer coefficients. Heating, Ventilation and Air Conditioning (HVAC)

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Discuss** principle of physics; and explain the concept of classical and modern physics to solve related problems	C2	1
2	**Use** the concept of classical physics for Engineering problems	C3	2
3	**Apply** the concept of modern physics to solve physical problems	C3	2

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **EA-128 Functional English**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education

COURSE CONTENTS

Listening Skills and subskills

Effective listening techniques: listening for gist, details, and specific information in a range of situations (AV lectures, interviews, documentaries, etc.)

Speaking Skills

Speaking with fluency and accuracy in a variety of situations including conversations, group discussion, academic and social interaction, public speaking, presentation, and interviews, Pronunciation improvement exercises (through websites, apps, and in class worksheets)

Reading and Subskills

Reading strategies: Skimming, scanning, and detailed reading, identifying main ideas, supporting details, and inferences (multiple genres including newspapers, books, stories, documentaries, etc.). Reading practice: Reading comprehension tasks. Reading output tasks (notes, summary, discussion, counter argument, etc.)

Study Skills

Effective note-taking strategies for lectures, meetings, and reading texts. Taking in varied forms paragraphs, lists, infographics, etc.). Interpreting instructions oral and written. Effective examination taking technique (comprehending instructions, planning, and writing answers ensuring relevance and precise

Writing Skills

Writing process, Pre-writing strategies (mind mapping, cubing, outlining, clustering, etc.). Writing to describe, argue, compare and contrast, persuade through writing prompts. Writing academic and professional genres: emails, letters, short report, resume, cover letter, building profiles on various job portals. Writing Accuracy: Identifying and overcoming grammatical problems.

Vocabulary and grammar development

Vocabulary development strategies. Exposure and practice to develop everyday and academic vocabulary for formal contexts.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Employ** effective study skills and strategies for various academic functions.	A3	9
2	**Comprehend** explicit and implicit information through reading and listening strategies.	C2	9
3	**Produce** various spoken and written genres for different academic and professional settings.	C6	11

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-133 Foundation of Biomedical Engineering**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-03 Good Health and Well-being

COURSE CONTENTS

Introduction to Biomedical Engineering

History; evolution; scope of biomedical engineering; multidisciplinary nature; role of engineers in healthcare.

Biomedical Engineering Specializations

Biomechanics; bioinstrumentation; biomaterials; rehabilitation engineering; and medical imaging.

Fundamentals of Biological Systems

Introduction to cellular biology; tissues; basic physiological concepts relevant to Biomedical Engineering; Cardiovascular system; respiratory system; nervous system: structure, function, relevance to engineering.

Molecular Biology

Fundamentals of cell structure and function; DNA; chromosomes; genome; gene expression: from DNA to protein; cell signaling and communication.

Biomedical Instrumentation

Basic concepts of bioinstrumentation; physiological signals and their acquisition.

Biomaterials and Tissue Engineering

Classification and properties of biomaterials; Basics of tissue engineering.

Medical Informatics

Hospital information system; computer-based patient record.

Medical Imaging Modalities

Classification of medical imaging (Radiology, radiotherapy, nuclear medicine); safety and applications of medica imaging modalities.

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Rehabilitation Biomechanics

Introduction to biomechanics related to human movement and structure.

Product Design and Development Engineering ethics; patient safety; FDA; ISO standards; medical device approval process;

Advances in Biomedical Engineering

Wearables; AI in healthcare; nanotechnology in diagnosis and drug delivery; regenerative medicine; organ-on-a-chip; computer aided diagnosis.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the multidisciplinary scope, historical evolution, and core domains of biomedical engineering.	C2	1
2	**Interpret** the functional relevance of physiological systems in analyzing biomedical engineering problems.	C2	2
3	**Apply** basic concepts of biomedical instrumentation, biomaterials, and medical imaging to healthcare problems	C3	2
4	**Perform** basic operational tasks on biomedical tools and equipment by imitating demonstrated procedures.	P1	1

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **CS-109 Computer Programming**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Basic Data types; Variables & Constants; Operators & Expressions; Input/ processing/output; Decision Making Control Structures; Loop Structure and their Implementations; Function and their Types; Arrays and Strings; Pointers and their Application; Structures and Union; Files and their Control; Hardware Interfacing Techniques.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Describe** fundamentals and semantics of computer programming	C2	1
2	**Apply** basic programming language structures	C3	3
3	**Practice** computer programming using constructs of a high level language (Lab work only)	C3	5

REMARKS (if any)

Recommended by _____ **Approved by** _____

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **MT-116 Calculus & Analytical Geometry**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Set and Functions

Define rational, irrational and real numbers; rounding off a numerical value to specified value to specified number of decimal places or significant figures; solving quadratic, and rational inequalities in involving modulus with graphical representation; Definition of set, set operations, Venn diagrams, De Morgan's laws, Cartesian product, Relation, Function and their types (Absolute value, greatest integer and combining functions). Graph of some well-known functions. Limit of functions and continuous and discontinuous functions with graphical representation.

Differential Calculus

Differentiation and Successive differentiation and its application: Leibnitz theorem. Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, power series. Taylor and Maclaurin series, L Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, extreme values of a function of two variables with and without constraints. Solution of non-linear equation, using Newton Raphson method.

Integral Calculus

Indefinite integrals and their computational techniques, reduction formulae, definite integrals and their convergence. Beta and Gamma functions and their identities, applications of integration relevant to the field.

Sequence & Series

Sequence, Infinite Series, Application of convergence tests such as comparison, Root, Ratio, Raabe's and Gauss tests on the behavior of series.

Analytical Geometry

Review of vectors, scalars and vector products, Three-dimensional coordinate system and equation of straight line and plane and sphere, curve tracing of a function of two and three variables, surface revolutions, coordinate transformation.

Complex Number

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and Hyperbolic functions).

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Solve** real and complex numbers problems.	C3	2
2	**Apply** calculus and analytical geometry to engineering problems.	C3	2
3	**Carry out** calculation to discuss the behavior of sequence and series.	C3	2

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EE-125 Basic Electrical Engineering**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **29 SEPTEMBER 2020**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Fundamentals of Electric Circuits

Charge, Current, Voltage and Power, Voltage and Current Sources, Ohm's Law. Equivalent resistance of a circuit.

Voltage and Current Laws

Node, Loop and Branches, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), single-loop circuits, single Node Pair Circuit, Series and Parallel Connected Independent Sources.

Circuit Analysis Techniques

Nodal Analysis, Mesh Analysis, Linearity and Superposition, Source Transformations, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer theorem.

Capacitors and Inductors

Capacitor, Inductor, Inductance and Capacitance Combination, voltage current relationship for inductor and capacitor. Energy storage.

Introduction to AC Circuits

Sinusoids and Phasors, Phasor Relationships for Circuit Elements, Impedance and Admittance, Kirchhoff's Laws in the Frequency Domain, Impedance Combinations, Instantaneous and Average Power, Maximum Average Power Transfer, Effective or RMS Value, Apparent Power and Power Factor, Complex Power, Conservation of AC Power.

Sinusoidal Steady-State Analysis

Nodal Analysis, Mesh Analysis, Superposition Theorem, Source Transformation, Thevenin and Norton Equivalent Circuits.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Have understanding** of basic circuit analysis laws and APPLY them to solve various electric circuits	C3	1
2	**To enable** students to use various techniques to solve and ANALYZE electric circuits and problems effectively	C4	2
3	**Have ability** to MANIPULATE various electrical circuits under guidance and ability to verify different network theorem experimentally	P3	2

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **ES-108 Ideology and Constitution of Pakistan**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-16 Peace, Justice, and Strong Institutions

COURSE CONTENT

Two-Nation Theory

Nation and Nationalism in British India. Inclusive nationalism, Exclusive nationalism, Freedom movement in British India, Two-Nation Theory.

Ideology: definition and its significance

Difference between Philosophy, Ideology, and Theory. Evolution of Islamic ideology in British India. Pakistan movement: role of ideology. Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).

Introduction to the Constitution of Pakistan

Definition and importance of a constitution. First Constituent Assembly of Pakistan. Main issues that delayed the Constitution-making in Pakistan. Dissolution of the Constituent Assembly. Second Constituent Assembly of Pakistan. Third Constituent Assembly of Pakistan.

Constitution and State Structure

Federal form of State. Parliamentary form of government. Structure of Government (executive, legislature, and judiciary). Distribution of powers between federal and provincial governments.

Fundamental Rights, Principles of Policy, and Responsibilities

Duty of the citizens of Pakistan (Article 5). Overview of fundamental rights to citizens of Pakistan guaranteed by the Constitution 1973 (Articles 8-28). Overview of Principles of Policy (Articles 29-40).

Constitutional Amendments

Procedures for amending the Constitution. Notable constitutional amendments and their implications: 8th, 13th, 17th, and 18$^{th.}$

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** the historical evolution of Islamic ideology in British India and critically evaluate its influence on the freedom movement and the basic principles of the Constitution of Pakistan.	C2	6
2	**Discuss** the foundational concepts of the Constitution of Pakistan, including the structure of the state, system of governance, key institutions, fundamental rights, and civic responsibilities of citizens.	C2	6

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-114 Anatomy**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-05 Gender Equality
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Anatomical Terminology and Methods

Descriptive anatomical terms; radiographic anatomy.

Skeleton

Upper limbs; chest; head and neck.

Skeleton Muscles

Anatomy of major muscles; muscle groups of upper limbs, head, neck, muscle of chest, muscle groups of lower limb, abdomen, and muscle of back.

Joints

Muscle groups and ligaments; movement and stability, shoulder, wrist, elbow and finger joints, hip, knee, and ankle joints.

Hands and Feet

The hand and feet as functional unit.

The Nervous System

Neuron types; gross anatomy of the brain and spinal cord; regions of the brain.

Cerebral cortex; cerebellum; brainstem; spinal cord; peripheral nervous system; sense organs

The Cardiovascular System

Anatomy of heart and blood vessels

The Respiratory System

Upper and lower respiratory tracts; gross and fine anatomy of the lungs.

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

The Gastrointestinal System

Organization of digestive system; mouth, esophagus, intestines, liver, gallbladder, and pancreas.

The Urinary System

Gross and fine anatomy of kidney and adrenal glands.

The Lymphatic System

Anatomy of lymph nodes, thymus, spleen, vessels and flow.

Skin

Layering of the skin

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** the human bones, muscles and joint's structure and relations	C2	1
2	**Illustrate** and RELATE the functional activities of human body like movement of different joints for different daily life activities	C3	2
3	**Analyze** and **Differentiate** the normal and abnormal functional activities of human body through teamwork including measurements or searching the research articles	C4	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-209 Basic Electronics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Solid State Theory

Atomic structure of elements; energy band diagram for solids; intrinsic and extrinsic semi-conductors; electron hole pairs; distribution of electrons and holes in a semi-conductor.

Network Theorems

Voltage and current sources Voltage Divider Rule, Current Divider Rule, Kirchhoff Current Law, Kirchhoff Voltage Law, Thevenin's and Norton's Theorem.

Diode & Its Applications

Diode; PN junction diode; forward; reverse characteristics of a diode. Ideal diode; practical diode; equivalent circuit of a diode; current equation of a diode; diode as a switch; diode as a rectifier; diode as clipper; diode as clamper; diode in gating circuits; breakdown diodes; voltage regulator.

Transistor (BJTS)

Junction transistors; construction and operation; static characteristic; transistors configurations; DC biasing of a transistor; types of biasing; biasing techniques; DC circuit analysis; load line; operating point and bias stabilization; transistor as amplifier; small signal operation.

FETS

Introduction to field effect transistor; JFETS and MOSETS.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Recall** the functions and symbols of electronics components	C1	1

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

2	**Describe** the basic construction and operation of electronic circuits by utilizing working mechanism of electrical components	C2	2
3	**Exercise** prototyping various electronic circuits by utilizing modern tools	P2	5
4	**Commit** to working with others for circuit designing through oral discussion	A3	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EF-201 Civics and Community Engagement**	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-12 Responsible Consumption and Production

COURSE CONTENTS

Introduction to Civics and Citizenship

Definition of civics, citizenship and civic engagement, Historical evolution of civics participation, Types of citizenship: active, participatory, digital etc. The relationships between democracy and citizenship

Civics and Citizenship

Concepts of civics, citizenship and civic engagement, Foundation of modern society and citizenship. Types of citizenship: active, participatory, digital etc.

State, Government and Civil Society

Structure and functions of government in Pakistan, The relationships between democracy and civil society, Right to vote and importance of political participation and representation

Rights and Responsibilities

Overview of fundamental rights and liberties of citizens under constitution of Pakistan 1973, Civic responsibilities and duties, Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.)

Community Engagement

Concept, nature and characteristics of community, Community development and social cohesion, Approaches to effective community Engagement, case studies of successful community driven initiatives

Advocacy and Activism

Public discourse and public opinion, role of advocacy in addressing social issues, Social action movements

Digital Citizenship and Technology

The use of digital platforms for civic engagement, Cyber ethics and responsible use of social media, Digital divides and disparities (access, usage, socioeconomic, geographic etc.) and their impact on citizenship

Diversity, Inclusion and Social Justice

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Understanding diversity in society (ethnic, cultural, economic, political etc.), Youth, women and minorities' engagement in social development, addressing social inequalities and injustice in Pakistan, Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the concepts of civics and community engagement for individuals and groups recognizing civil rights, responsibilities, ethics and diversity for a better society.	C2	6
2	**Recognize** the importance of diversity and inclusivity for long-term societal harmony and peaceful co-existence	A3	11

REMARKS (if any):

Recommended by _____ (Chairperson/Date)

Approved by _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-230 Biochemistry**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Basic Concepts of Biochemistry

Brief review of organic chemistry; overview of cellular structures and processes; acids, bases and buffers; amino acids and peptide bonds; protein structure and function; enzymes; biochemical basis of diseases; use of biochemical measurements for diagnosis.

Protein Synthesis through Gene Expression

Nucleic acid structure: RNA and DNA; the genome; DNA synthesis (replication); RNA synthesis (transcription); protein synthesis (translation); regulation of gene expression; recombinant DNA and biotechnology.

Bioenergetics

Thermodynamics of biological processes; adenosine triphosphate (ATP) and phosphoryl group transfers; oxidation-reduction reactions; ATP synthesis via oxidative phosphorylation in mitochondria.

Carbohydrate Metabolism

Carbohydrate structure, glycoconjugates: proteoglycans, glycoproteins, and glycolipids; digestion of carbohydrates; glycogen structure and metabolism; glycolysis; gluconeogenesis; the pentose phosphate pathway; regulation of glycolysis and gluconeogenesis; the citric acid cycle.

Lipid Metabolism

Lipids and membranes; digestion of triacylglycerol; fatty acid and triacylglycerol synthesis; triacylglycerol storage in adipose tissues; cholesterol and bile salt metabolism; blood lipoproteins; fatty acid oxidation; ketone body synthesis and utilization; phospholipid and sphingolipid metabolism.

Nitrogen Metabolism

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Protein digestion and amino acid absorption; the urea cycle; synthesis and degradation of amino acids; role of various tissues in amino acid metabolism; molecules derived from amino acids.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Acquire** knowledge of biochemical and biophysical processes at the molecular level and explain the structure, classification, and function of essential biomolecules.	C1	1
2	**Analyze** metabolic pathways and biomolecular activities to interpret physiological states, considering ethical implications in biomedical contexts.	C3	7
3	**Perform** standard biochemical laboratory procedures to assess and analyze biomolecules, ensuring adherence to biosafety and procedural protocols.	P3	4

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE	SEMESTER	CREDIT HOURS
MT-221 Linear Algebra & Ordinary Differential Equations	**□ SPRING ■ FALL**	**TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENT

Linear Algebra

Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, matrix of linear transformations, eigen value and eigen vectors of a matrix, Diagonalization. Applications of linear algebra in relevant engineering problem.

1st Order Differential Equations

Basic concept: Formation of differential equations and solution of differential equations by direct integration and by separating the variables: Homogeneous equations and equations reducible to homogeneous from; Linear differential equations of the order and equations reducible to the linear form; Bernoulli's equations and orthogonal trajectories: Application in relevant Engineering.

2nd and Higher Orders Equations

Special types of IInd order differential equations with constant coefficients and their solutions: The operator D; Inverse operator I/D; Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations; simple application of differential equations in relevant Engineering.

Partial Differential Equation

Basic concepts and formation of partial differential equations: Linear homogeneous partial differential equations and relations to ordinary differential equations: Solution of first order linear and special types of second and higher order differential equations; D' Alembert's solution of the wave equation and two-dimensional wave equations: Lagrange's solution; Various standard forms.

Fourier Series

Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients: Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Describe** formation of differential equations and system of linear equations to explain physical situations	C2	1
2	**Apply** appropriate methods to solve differential equations and system of linear equations of relevant engineering problems.	C3	2

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EE-217 Circuit Theory**	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **16 OCTOBER 2020**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Matrix Analysis

Introduction and review of Matrix theory determinants and matrix inversions, Systematic formulation of network equations, Loop variable analysis, State variable analysis, formulation of state equations, source transformations Duality.

Elementary Transient Analysis

Differential and integral forms of circuit equations, Initial voltage on a capacitor, Initial current in an inductor, First order circuits, Solution of single first order differential equations, particular and total solution of second order linear time invariant differential equations.

Elementary Time Functions

Introduction to singularity functions, The impulse functions and response, The unit step function and response, Ramp function, Exponential function & response.

Exponential Excitation and the Transformed Network

Representation of excitations by exponentials functions, Single element response, forced response with exponential excitation, Introduction to the transformed network, Driving point impedance and admittance.

Laplace Transformation

Analysis of networks by Laplace transformation, Review of Laplace transformation, Application to network analysis.

Two Port Network

Introduction, Characterization of linear time invariant two-ports by six sets of parameters, Relationship among parameter sets, Interconnection of two ports.

Networks Functions and Frequency Response

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

The concept of complex frequency, transform impedance and transform circuits, Network functions, One & Two ports. Poles and zeros of network functions, Restrictions on pole and zero transfer function, magnitude and phase, Complex Loci's plots from the plane phasors.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** linear circuits by using network laws and theorem.	C2	1
2	**Illustrate** the output by examining transient response and forced response of first and second order circuits.	C3	2

REMARKS (if any):

Recommended by _____

(Chairperson/Date)

Approved by _____

(Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-232 Human Physiology**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-05 Gender Equality
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction to Human Physiology

The overall body plan; homeostasis; negative and positive feedback.

Control in Homeostasis

Organs; organ system.

Cellular Physiology

Cell membrane; transport mechanisms; cell membrane transport.

Nervous System

Neurons; synapses; electrical signaling; neurotransmitters; neural integration; central and peripheral nervous system, sensory and motor pathways; autonomic nervous system.

Musculoskeletal System

Muscle contraction; neuromuscular coordination.

Cardiovascular System

Electrical activity of heart; cardiac cycle; blood flow and blood pressure; blood.

Respiratory System

Mechanism of breathing; lung volumes and capacities; pulmonary function test; gas exchange; regulation of breathing.

Renal system

Basic renal exchange processes; fluid and electrolytes balance.

Digestive system

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Digestion and absorption of nutrients and water; gastric secretion and mobility.

Endocrine System

Pituitary hormones; thyroid hormone; insulin.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** and **Explain** the structural organization and functional integration of various activities of different systems of human body	C2	1
2	**Interpret** and **Associate** the functioning of the normal and abnormal physiological systems of human body	C2	9
3	**Analyse** and **Distinguish** the normal and abnormal functions of different systems of human body	C4	4
4	**Recognize** the normal and abnormal results of the experiments performed under supervision	P1	2

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-208 Biomedical Electronics**	SEMESTER ■ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

MOSFET

MOS as an amplifier; small signal operation; MOS configuration; MOS internal capacitance.

Power Amplifier

Class A; class B; class AB; class C; application in biomedical.

Operational Amplifier

Introduction; inverting and non-inverting configuration; parameters; difference amplifier; summing amplifier; comparators; integrators; differentiators; isolation amplifier; IC LM 741; digital to analog converter.

Filters

Active; passive; low-pass; high-pass; bandpass; band stop; Chebyshev; Butterworth filters; filters application in biomedical.

Oscillators

Principle; conditions; Sinusoidal oscillators; non-sinusoidal oscillators; 555 timer IC (astable and monostable); application in biomedical.

Introduction to BiCMOS

Cascaded and cascaded configuration; application in biomedical.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** working of amplifiers, oscillators, and signal conditioning circuits.	C2	1
2	**Analyze** and **Compare** electronics circuits used for amplification, wave shaping, and filtration.	C5	3

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

3	**Conduct** experiments on their own and can learn software and hardware skills.	P3	5
4	**Describe** the basic circuits design skills necessary for upgrading biomedical engineering knowledge	C2	11

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-130 Computer Aided Engineering Graphics**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 □2 ■1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction to Computer Aided Drafting

Introduction to the Engineering design Process, Technical Graphics basics, Orthographic projection and Isometric drawings and basic concepts of Conventional engineering drawings. Opening a new drawing, paper setting, coordinate systems: User's coordinate system (UCS), Cartesian coordinates and Polar coordinates; saving a drawing.

Creating Elementary Objects

Apply the Commands: Grid, Ortho, Escape, Erase, Trim, Undo, Draw Lines, Circles, Ellipse, Rectangle, And Arcs.

Basic Object Editing

Apply the following commands: Move, offset, rotate, fillet, chamfer, array and mirror.

Dimensioning

Show the following dimensioning: Linear, aligned, radial and changing dimensional setting.

Solid Modeling

Apply the following commands to create 3-D models: Region, extrude, revolve, slice and show plan; elevation and end view of a 3-D model.

Controlling Drawings

Apply the following commands for a given drawing: Hatching, coloring and rendering.

Text

Apply the following commands on the given drawing: Creating text, style of text and changing text properties.

Plotting Drawings

Apply the following commands: Plotting, print preview and printing.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** basics of engineering drawing and able to draw projections of 3D Models.	C2	1
2	**Imitate** 2D and 3D Models by using modern tools and commands	P3	5

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **TC-205 Digital Logic Design**	SEMESTER ■SPRING ☐ FALL	CREDIT HOURS TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **03 JANUARY 2024**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Combinational Logic Design

Logic gates, Boolean Equation, Boolean Algebra, Multilevel Combinational Logic, Karnaugh Maps, Combinational Building Blocks (Multiplexers and Decoders), NAND and NOR based combinational circuits, and Multiplexer based combinational circuit.

Sequential Logic Design

Latches, Flip Flops, Registers, Counters, Finite state machines, Pipelining, Timing issues of sequential logic.

Programmable Logic Devices (PLDs)

Introduction to PLDs, Structure of complex PLDs, Structure of FPGA.

Hardware Description Language (HDL)

Introduction to HDL coding, HDL coding of Combinational logic, HDL coding of Sequential Logic, HDL coding of Finite state machine, and basic of Test benches.

Computer Architecture

RISC and CISC architecture, Addressing modes, Cache, Machine/assembly instruction, Micro architecture**.**

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Apply** digital design knowledge to build basic computer architecture concept.	C3	1
2	**Design** and analyze combinational and sequential digital circuits.	C5	3
3	**Use** computer aided tools and discrete component to IMITATE digital circuits	P3	5

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EF-309 Occupational Safety & Health**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ☐2 ■1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being

COURSE CONTENTS

Health and Safely Foundations

Nature and scope of health and safety, Reasons/benefits and barriers for good practices of health and safety, Legal framework and OHS Management System

Fostering a Safety Culture

Four principles or safely- RAMP (Recognize, Assess, Minimize, Prepare), Re-thinking safety-learning from incidents, Safety ethics and rules, Roles and responsibilities towards safety, Building positive attitude towards safety, Safety cultures in academic institutions.

Recognizing and Communicating Hazards

Hazards and Risk, Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and Lifting etc., Learning the language of safety: Signs. symbols and labels, Finding Hazard Information, Material safety data sheets, Safety data sheets and the GHS (Globally Harmonized Systems)

Accidents & Their Effect on Industry

Costs of accidents, Time lost, Work injuries. parts of the body injured on the job, Chemical burn injuries, Construction injuries, Fire injuries.

Assessing and Minimizing the Risks from Hazards

Risk Concept and Terminology, Risk assessment procedure, Risk Metrics, Risk Estimation and Acceptability Criteria, Principles of risk prevention, selection and implementation of appropriate Risk controls, Hierarchy of controls

Preparing for Emergency Response Procedures

Fire, Chemical Spill, first Aid, Safety Drills/Trainings: Firefighting, Evacuation in case of emergency

Stress and Safety at work Environment

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Workplace stress and sources, Human reaction to workplace stress, Measurement of workplace stress, Shift work, stress and safety, improving safety by reducing stress, Stress in safety managers, Stress and workers compensation.

Incident Investigation

Importance of investigation, Recording and reporting, Techniques of investigation, Monitoring, Review, Auditing Health and Safety

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the core principles of occupational health and safety, workplace stress management and identify the types of risks and mitigation.	C2	6
2	**Adopt** procedures to the standard safety practices with risk mitigation strategies in the workplace.	A3	11

REMARKS (if any):

Recommended by _____ (Chairperson/Date)

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EA-244 Academic Reading & Writing**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education

COURSE CONTENTS

Introduction to Academic Literacy

Academic reading, writing, and expectations. (Academic v/s non-academic texts); Finding, evaluating, and presenting credible academic sources.; Critical Reading: Identifying main ideas, annotating texts, and analyzing arguments; Academic Texts: Structure of research proposals, Arguments & Evidence Writing Logical reasoning, integrating evidence, and avoiding fallacies, journal articles, literature review, lab report, policy brief, case study etc.; Academic Writing- Tone, voice, formal vs. informal writing, and structured paragraphs; Academic Vocabulary Development: Discipline-Specific Academic Vocabulary

Academic Writing Process

Outlining, organizing, and refining essay plans; Writing Introductions: Engaging openings, summarizing key points, and implications; Synthesizing Research: Connecting multiple sources and writing literature and critical reviews; Drafting & Revising: Overcoming writer's block, refining drafts, and incorporating feedback; Editing & Proofreading: Improving clarity, grammar, style, and structure. Add attention to technical formatting (e.g., equations, symbols, figures in STEM fields); Citation & Referencing: Using APA or IEEE styles and integrating sources.

Interpreting Visuals: Charts, graphs and tables

Drawing logical conclusions from information contained in graphs, diagrams, pie charts and tables with specific reference to the relevant disciplines and their requirements.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Comprehend** explicit and implicit information in various academic texts and using relevant reading strategies.	C2	9
2	**Compose** organized, coherent, and effective texts and visuals for various academic genres using writing processes and strategies.	C6	11

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

3	**Use** paraphrasing, summarizing, and referencing skills to avoid plagiarism.	C3	9

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **EF-200 Community Service**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ☐2 ☐1 ■0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-12 Responsible Consumption and Production
SDG-13 Climate Action

COURSE CONTENTS

Orientation to Community Service: [Taught component]

Introduction to the concept and practice of community service. Need, objectives and benefits of community service. Foundational theories (educational, undergraduate curriculum, humanities, social science, corporate social responsibility etc.). Tools and skills needed in community service. Contextual examples in community service; case examples. Professional and ethical conduct during community service

Community Service Attachment

Completing 30-35 hours of formal assignment at an organization

Community Service Experience Documentation

Writing a report documenting the experience and submitting it on the prescribed format.

NOTE: Total contact hour for theory (thought component 8 + documentation activity 6) will be 14 hours.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Express** an interest in contributing to the community and society individually and collectively through social projects	A3	6
2	**Volunteer** to help make a difference to a specific group, community, or organization	A2	11

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-306 Bioinstrumentation & Measurements – I**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-133 Foundation of Biomedical Engineering**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Types of Biosignals

Various forms of biosignals (bioelectric, biochemical, biomechanical, bio acoustic, bio-optic).

Basic Sensors and Transducers

Active and passive transducers; displacement sensors; inductive and capacitive sensors; piezoelectric sensors; temperature sensors; optical sensors; radiation sensors; electro-chemical sensors; bio sensors; fibre optics.

Medical Instrumentation

Introduction to (medical) instrumentation; accuracy; sensitivity; reproducibility; biocompatibility; classification; measurement constraints; invasive & non-invasive techniques; design criteria.

Biopotentials and Measurements

Different types of electrodes (EEG, ECG, EMG, ERG, MEG); Application of amplifier and filters in electrocardiograph; vectorcardiograph; phonocardiograph; electroencephalograph; electromyography; apexcardiograph; ballistocardiograph; electrooculograph; electroretinograph. Telemedicine & biotelemetric systems

Measurements and Reporting

Measurements & reporting, graphs, records, time-variant and quantitative variance records; statistical data compiling techniques; real time data transport; future aspects.

Hazards and Safety

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Physiological effects of electricity; micro and macro shock hazards; electrical safety codes and standards; basic approaches for protection against shock; protection equipment design; electrical safety analyzers; testing the electric system; testing of electrical appliances.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the basic concepts related to the classification techniques and working principles of biomedical equipment.	C2	1
2	**Conceptualize** the design of biomedical solutions using sensors, transducers, and biopotentials while assuming responsibility to work effectively as a team member.	A4	8
3	**Construct** operational prototypes using fundamental components and software tools for various biomedical applications.	P3	3
4	**Demonstrate** an ability to apply project management skill in developing engineering solutions for different medical issues.	C5	10

REMARKS (if any):

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NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-314 Project Management**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction to Project Management

Overview of project management principles; relevance to biomedical engineering; stakeholders; project life cycle; project phases.

Project Initiation

Project selection and feasibility; problem definition and need identification; writing a project charter.

Project Planning Tools and Techniques

Work breakdown structure; gantt charts; Program evaluation review technique diagrams; scope management.

Time and Cost Estimation

Time estimation techniques; budgeting; cost estimation; resource allocation.

Risk Management

Risk identification and assessment; risk mitigation strategies; engineering-specific risks.

Quality Management

Quality assurance and quality control; six sigma; total quality management; applications in medical devices and diagnostics.

Team Management and Communication

Leadership and team dynamics; communication plans and stakeholder engagement; conflict resolution.

Procurement and Contract Management

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Vendor selection; procurement challenges; contract types and legal considerations.

Project Execution and Monitoring

Key performance indicators; monitoring tools and reporting; change control.

Case Studies in Project Management

Scenario based case studies; inferences from industry and research projects. Project management course gives students key skills to plan, organize, and complete tasks efficiently. It prepares them for real-world work, improves teamwork and leadership, and boosts career readiness.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Organize** project tasks and team roles using project life cycle phases and stakeholder engagement strategies.	C3	8
2	**Explain** the principles of project budgeting, cost estimation, and resource allocation in the context of biomedical engineering project planning	C2	10

REMARKS (if any):

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(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-315 Biomechanics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-133 Foundation of Biomedical Engineering**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-08 Decent Work and Economic Growth
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Foundations of Biomechanics
Overview of statics and dynamics relevant to biomechanics; biomechanics versus kinesiology; linear motion; angular motion; anatomical movement descriptors; reference systems; planes and axes; applications in movement analysis.

Linear Kinematics
Methods of calculating joint angles during motion; projectile motion; first central difference method; linear kinematics of walking and running.

Angular Kinematics
Angular motion; joint angles; muscle forces; angle-angle diagrams; angular kinematics of walking and running.

Linear Kinetics
Force; composition; resultant; analysis via laws of motion; linear kinetics of walking and running.

Angular Kinetics
Torque and moment of forces; segmental method; classes of lever; external forces and moments acting on upper and lower extremities.

Biomechanical Aspects of Skeletal System
Biomechanical characteristics of bone and applied loads; stress fractures; mechanical properties of body tissues, and synovial joint; osteoarthritis.

Biomechanical Aspects of Muscle Mechanics
Muscle force generation principles; hill mechanical model of muscles; muscle architecture and types of contractions; force-velocity relationships in muscles.

Biomechanics Rehabilitation Technologies
Wearable sensors; exoskeletons; and assistive devices.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** gross human movements using anatomical terminology and apply basic biomechanical principles to the analysis of human motion	C3	1
2	**Utilize** experimental tools and techniques for analyzing human movement in biomechanical contexts	P2	2
3	**Assess** the impact of altered movement patterns and techniques on human performance in daily, clinical, and research settings	C5	6
4	**Analyze** biomechanical properties of bones, joints, muscles, and the spine under different loading conditions relevant to injury prevention and rehabilitation.	C4	4

REMARKS (if any):

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(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-312 Biostatistics**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education
SDG-09 Industry Innovation and Infrastructure
SDG-17 Partnership for the Goals

COURSE CONTENTS

Overview

Biostatistics; types of data and data representation; descriptive statistics; measures of central tendencies; measures of dispersion; Chebyshev's inequality.

Probability Concepts

Permutation and combination; elementary properties of statistics; conditional probability; Bayes' theorem.

Diagnostics Tests

Sensitivity and specificity; ROC curve; prevalence; relative risk; odds ratio; life table; rates and standardization (vital statistics).

Probability Distributions

Binomial distribution; Poisson distribution; normal distribution.

Sampling Distribution of Mean

Sampling distribution; central limit theorem and its application.

Estimation (or Confidence Interval)

One-sided and two-sided confidence interval; student's t distribution.

Hypothesis Testing

Tests of hypothesis; types of error; power; sample size estimation.

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Comparison of Two Means

Paired samples; independent samples; correlation.

Linear Regression

Models and their evaluation.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Understand** and **Explain** the concepts of Descriptive statistics for life sciences by looking into vital statistics and demographic data	C2	1
2	**Describe** the concepts of probability distributions, sampling and, estimation to PREPARE and verify Hypotheses through testing.	C2	2
3	**Apply** statistical tests and interpret results to draw conclusions related to public health or clinical scenarios	C3	6
4	**Utilize** statistical tools and software to perform data analysis and interpret results, demonstrating awareness of their applications and limitations.	P3	5

REMARKS (if any):

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(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **CS-354 Microprocessor Programming and Interfacing**	SEMESTER ☐ SPRING ■ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Computer Instruction Set, Instruction Types, General and Special Purpose Registers, Assembly Language Programming, Instruction Encoding, Processor's Datapath and Control Unit, Memory Hierarchy and Organization, Memory Addressing, Memory Interfacing, Interrupts, Interrupt Service Routines, Programmed Input/Output (I/O), Interrupt-Driven I/O, I/O Interfacing, Timing and Clocking of Computer Operations, Reduced Instruction Set Computing (RISC) and Complex Instruction Set Computing (CISC) Architectures, Introduction to Microcontroller Architectures, Introduction to Embedded Systems Design, Microprocessors in Biomedical Applications.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explore** internal microprocessor architecture and operations	C3	1
2	**Illustrate** interfacing techniques of a microprocessor with memory and I/O devices	C4	2
3	**Simulate** and probe instruction set architecture of a representative microprocessor (Lab work only)	C3	5

REMARKS (if any):

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(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-313 Biomaterials**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **BM-133 Foundation of Biomedical Engineering**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-13 Climate Action
SDG-14 Life below Water

COURSE CONTENTS

Overview

Historical development and impact of biomaterials.

Structure and Properties of Materials

Crystalline and non-crystalline materials; atomic molecular and crystal structure of solids; atomic binding in solid; crystal imperfections; mechanical properties and testing of materials; heat treatments; surface properties and improvement.

Metals

Introduction to ferrous and non-ferrous metals; steel and its alloys; rare earth metals; types of nonferrous alloys; corrosion and degradation of materials; biocompatibility of materials.

Ceramics

Introduction to ceramics; structure and properties; surface reactive ceramics; analysis of ceramic surfaces.

Polymers and Biopolymers

Polymers in biomedical use; polyethylene; polypropylene; perfluorinated; acrylic; hydrogels; polyurethanes; polyamides; biodegradable synthetic polymers; silicone rubber; plasma polymerization; microorganisms in polymeric implants; polymer sterilization. Introduction; collagens; elastin; mucopolysaccharides; proteoglycans; cellulose and derivatives; chitin; other polysaccharides.

Composites Material

Anisotropy; particulates; fibrous and porous materials; biocompatibility.

Applications of Biomaterials in Different Fields of Medicine

Strength of biological tissues; performance of implants; tissue response to implants; safety and efficacy testing; tissue grafts; soft tissue applications; cardiovascular implants and extracorporeal devices; biomaterials in ophthalmology; orthopedic implants; dental materials.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Define** the fundamental concepts and principles of biomaterials, their types and structures, characteristics of biomaterials, material fabrication techniques and their testing	C1	1
2	**Analyse** material type based on their performance curves (stress vs strain, phase diagram) and provide solutions for existing problems associated with biomaterials.	C2	3
3	**Apply** knowledge from basic concepts of materials to propose a solution using sustainable or degradable materials for better environmental impact.	C3	6
4	**Use** Tools for characterization of biomaterials	P1	5

REMARKS (if any):

Recommended by _____ (Chairperson/Date)

Approved by _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-310 Control Systems for Biomedical Engineers**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **EE-217 Circuit Theory**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction

A History of Control Systems; System Configurations; Analysis and Design Objectives; The Design Process; Control Systems Engineer.

Modeling in the Frequency Domain

Laplace Transform Review; The Transfer Function; Electrical Network Transfer Functions; Mechanical System Transfer Functions; Electromechanical System Transfer Functions; Nonlinearities; Linearization.

Modeling in the Time Domain

General State-Space Representation; Applying the State-Space Representation; Converting a Transfer Function to State Space; Converting from State Space to a Transfer Function; Linearization.

Time Response

Poles, Zeros, and System Response; First-Order Systems; Second-Order Systems; Underdamped Second-Order Systems; System Response with Additional Poles; System Response with Zeros; Effects of Nonlinearities Upon Time Response.

Reduction of Multiple Subsystems

Block Diagrams; Signal-Flow Graphs; Mason's Rule.

Stability

Routh-Hurwitz Criterion; Routh-Hurwitz Criterion Special Cases; Stability in State Space

Steady-State Errors

Steady-State Error for Unity Feedback Systems; Static Error Constants and System Type; Steady- State Error Specifications; Steady-State Error for Disturbances; Sensitivity.

Root Locus Techniques

Root Locus; Properties of the Root Locus; Sketching the Root Locus; Refining the Sketch; Transient Response Design via Gain Adjustment; Generalized Root Locus; Root Locus for Positive-Feedback Systems; Pole Sensitivity

Design Via Root Locus

Improving Steady-State Error via Cascade Compensation; Improving Transient Response via Cascade Compensation; Improving Steady-State Error and Transient Response; Feedback Compensation.

Frequency Response Techniques

Asymptotic Approximations Bode Plots; Nyquist Criterion; Sketching the Nyquist Diagram; Stability via the Nyquist

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Diagram; Gain Margin and Phase Margin via the Nyquist Diagram; Stability, Gain Margin, and Phase Margin via Bode Plots; Relation Between Closed-Loop Transient and Closed-Loop Frequency Responses.

Design Via Frequency Response

Transient Response via Gain Adjustment; Lag Compensation; Lead Compensation; Lag-Lead Compensation

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Understand** and **Describe** the basic principles of control engineering and designing of control systems.	C2	1
2	**Illustrate** models of control systems through transfer functions, block diagrams and state spaces.	C3	2
3	**Analyze** a model through investigation of its performance and analysis of its response, errors, and stability.	C5	4
4	**Apply** simulation and computational tools to model and analyze control system behavior in biomedical engineering applications.	P2	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-311 Bioinstrumentation & Measurements-II**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH ■3 □2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Blood Pressure Measurement

Direct and Indirect mechanisms, Invasive and non-invasive techniques, Different transducers, and their working, Measuring venous pressure

Cardiac Devices

Cardiac Pacemakers, Fibrillations and Defibrillators, Implantable and External Pacemakers, DC and Implantable defibrillators, Cardiac Output measurement, Indicator Dilution method, Thermal Dilution method, Dye dilution method, Oximeters, in-vivo and in-vitro oximetry, different types of oximeters.

Instrumentation of Auto Drug Delivery System

Infusion pumps, Components of drug infusion systems, Implantable infusion Systems, Closed loop control in infusion systems.

Hemodialysis Machine

Mechanism of dialysis and dialyzers, Membrane role, Electrical circuits of temperature and conductivity control of dialysate, Ultra-filtration rate monitor, Performance characteristic of dialysis machine.

Ventilator

Parameters of respiration, Artificial ventilation mechanism, Ventilators, Types of ventilators, Ventilator terms

Frequency and time dependent graphical representation, Pressure flow diagrams, Modern ventilators

Surgical Instruments, Anesthesia Machine, Lithotripters, Physiotherapeutic and Electrotherapeutic Devices

High frequency heat therapy, Shortwave and microwave diathermy, Ultrasonic therapy, Pain relief theory, Electric stimulation

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Identify** a range of components, relevant sensors, and used in particular application including Chromatography, spectroscopy, microscopy, Centrifuge machine, and chemistry analyzers	C1	1
2	**Illustrate** the use of different electronic circuits, software tools, and concept of applied sciences required for the design of biomedical applications.	C2	3
3	**Demonstrate** the working of various medical equipment, their safety requirements, and risks associated with them to patients.	P2	6
4	**Understand** the complexity of medical instruments and learn the sustainable solution for effective health care delivery.	A4	9

REMARKS (if any):

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(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-316 Artificial Intelligence in Healthcare**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **CS-109 Computer Programming**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction to Artificial Intelligence

Basic definitions; history and evolution of AI in medicine; its advantages and limitations.

Supervised Learning

Regression and classification techniques; common algorithms: linear/logistic regression, decision trees, etc.; applications: diagnosis prediction, outcome estimation.

Unsupervised Learning and Data Exploration

Clustering methods and dimensionality reduction; applications in patient segmentation and disease profiling.

Deep Learning and Neural Networks

Basics of deep learning and neural networks; use cases: anomaly detection, time-series data analysis.

AI in Medical Imaging

Introduction to convolution neural networks and image analysis; use cases in radiology and diagnostics; image formats and annotation tools.

Clinical Decision Support and Personalized Medicine

AI-enabled decision support systems; predictive analytics and precision medicine; role of wearables, remote monitoring, and telehealth.

Ethical and Regulatory Considerations

Data privacy, bias, and explainability in AI systems; legal and regulatory frameworks

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** fundamental AI concepts, learning paradigms, and their evolving role in medical diagnosis, imaging, and decision support.	C2	1
2	**Analyze** applications of supervised, unsupervised, and deep learning techniques in healthcare, considering their strengths, limitations, and ethical implications.	C4	6
3	**Plan** and **Implement** AI-based classification or clustering models on healthcare datasets as part of a team project, demonstrating task delegation, time management, and resource coordination.	P3	10

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE	SEMESTER	CREDIT HOURS
EE-493 Digital Signal Processing	■ SPRING ☐ FALL	TH ■3 ☐2 ☐1 ☐0 PR ☐3 ☐2 ■1 ☐0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Overview of Discrete-time Signals and Systems

Sampling, Aliasing, Quantization, Convolution, Correlation, Properties of Discrete time Signals and Systems.

Linear Constant Coefficient Difference Equations

Modeling discrete systems, conversion of differential equations into difference equations, solution of difference equations.

Discrete Time Fourier Series

Representation of discrete time periodic signals, signal analysis using discrete time Fourier series, properties of discrete time Fourier series.

Discrete Fourier Transform

Frequency Domain Sampling, DFT Properties, Inverse DFT, Windowing and DFT Leakage, Direct Computation of DFT.

Fast Fourier Transform

Divide and Conquer, Radix algorithms; Inverse FFT, Applications of FFT.

Discrete time systems implementation

Overview of z-transform, Analysis of discrete system, Structures of Discrete time systems, Fixed and Floating number types, Quantization effects.

Design of Digital Filters

General Considerations, FIR and IIR Filters, Techniques of FIR and IIR filter Design.

Multi-rate Signal Processing

Down-sampling and Up sampling, Decimation and Interpolation.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Identify** constraints for discretizing continuous time signal	C1	1
2	**Analyze** discrete signals using Fourier series, Fourier transforms, and z-transform techniques and should have understanding of formulating and optimizing analysis techniques	C4	4
3	**Design** and analyze discrete-time systems with the help of various techniques (difference equation, convolution and frequency domain techniques)	C5	3
4	**Practice** experimental verification of the analytical and design techniques developed for discrete time signals and systems.	P3	4

REMARKS (if any):

Recommended by _____ (Chairperson/Date)

Approved by _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-451 Biosignal Processing**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **BM-133 Foundation of Biomedical Engineering**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Overview of Recording Techniques for Biosignals

Electrocardiogram, Electroencephalogram, Electromyogram, Functional Magnetic Resolution Imaging, Electrooculogram

Filtration of Biosignals

FIR and IIR filters on biosignals, Filters with windowing functions on biosignals

Time domain analysis methods

Concept of correlation analysis in biomedical signals, Event-related Potential in EEG/LFP, Techniques for detection of EEG and ECG rhythms, EMG signal processing

Frequency Domain analysis

Spectrum analysis, Connectivity Analysis

Time-frequency domain analysis methods

Wigner distribution, Short-time FFT, Wavelet analysis on biomedical signals

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the use of methods and techniques for recording and processing bio-signals	C2	1
2	**Apply** regular processing techniques for studying differences in bio-signals to proposing sustainable solutions of problems under different conditions	C3	6
3	**Conduct** experiments on their own for recording, processing, and analyzing bio-signals	P3	2

REMARKS (if any):

Recommended by _____ **Approved by** _____

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-406 Biomedical Imaging**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction

Introduction to medical imaging; overview of major modalities such as Radiography; Ultrasound and Magnetic Resonance Imaging (MRI).

X-Ray

Underlying Physics: Interaction techniques of X-Rays with matter; generation of X-Rays; radiation interaction.

Technical mechanism; Structure and Applications: X-Ray tube design; X-Ray generator; basics of film/screen radiography; properties of film/screen cassettes; basic theory of film processing; latent image formation; wet and dry processing; propagation model; biological relevant measure for energy transfer; biological damage from ionization. Applications of X-Ray imaging.

Ultrasound

Underlying Physics: Acoustical physics and acoustical waves in human tissue; emphasis on ultrasound transmission in soft tissues; attenuation of sound energy; parameters affecting sound transmission; resolution of sound beams.

Technical Structure: Theory of ultrasound unit; sound reflection; refraction; scattering and attenuation; piezoelectric transducers; ultrasound beam; resolution; focusing and steering; Doppler ultrasound & limitations; ultrasound bio-effects and safety; quality and safety assurance for diagnostic ultrasound devices.

Computed Tomography (CT)

Basic principles; system components; working of scanning systems; different generations of CT scans; detectors; processing unit and display.

Magnetic Resonance Imaging (MRI)

Underlying Physics: Fundamentals of magnetism and magnetic residence; proton density; Larmor frequency; free induction decay; principles of magnetic residence; magnetic properties of tissues.

Technical Structure: Principles of magnetic resonance imaging; pulse sequence; measurement parameter and image contrast; artifacts; motion reduction artifact techniques; multi-planar acquisition; MR safety; quality assurance; applications.

Nuclear Medical Imaging

Radioisotopes in medical diagnosis; the gamma camera; single photon emission computed tomography (SPECT); positron emission tomography (PET scanner).

Digital Image Processing

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Digital image representation, reading images, displaying, writing, data classes, indexing, filtering, image restoration, compression, and segmentation.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** the fundamental concepts related to radiation physics involved in biomedical imaging instruments, image reconstruction and image enhancement	C2	1
2	**Demonstrate** the fundamental concepts of radiation physics involved in biomedical imaging instruments, image reconstruction and image enhancement along with working mechanism and construction of the radiology equipment/module, including X-ray radiography, fluoroscopy, Ultrasound Imaging, Nuclear medicine, and X-ray Computed Tomography.	C3	2
3	**Practice** the steps shown for image processing in order to execute various tasks.	P3	4
4	**Classify** various health issues from the associated medical images and exhibit the steps of image processing techniques.	A4	9

REMARKS (if any):

Recommended by _____ (Chairperson/Date)

Approved by _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-401 Numerical Methods for Biomedical Engineers**	SEMESTER □ SPRING ■ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-04 Quality Education
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Error Analysis

Error types; significant digits; numerical instability.

Linear Operators and Difference Equations

Functions of operators; difference operators and derivative operators; identities; linear homogenous and non-homogenous difference equations.

Solution of Linear Equations

Numerical methods for finding the roots of linear equations (Gaussian Elimination, Gauss-Jordan, triangularization, Cholesky; Jacobian and Gauss-Seidel).

Non-Linear Equations and Solution Techniques

Nonlinear equations in biomedical engineering; finding the roots of an equation; convergence testing; finite difference methods; numerical integration; differential equation models; setting up an appropriate model; writing equations from a state diagram; stability analysis; stiff and non-stiff systems.

Interpolation and Curve Fitting

Linear; polynomial; and spline interpolation methods; least squares approximation; nonlinear curves.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Demonstrate** understanding of common numerical methods and how they are used to	C3	1

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

	obtain approximate solutions to otherwise intractable mathematical problems in life sciences		
2	**Analyze** and **Evaluate** the accuracy of common numerical methods.	C4	2
3	**Apply** numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations in life sciences	C3	4

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-452 Modelling and Simulation for Biomedical Engineers**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 ■1 □0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction

Modelling and Simulation in Biomedical Engineering, types of Models e.g., graphical model, Quantitative models, Multiscale Models, Hybrid models. Examples and applications using software (MATLAB and R). Conceptual modelling along with its rationale. Conceptual model of cardiorespiratory system, subdivision of Physiology models and combining of basic elements of conceptual models e.g., heart, muscles, eye etc. Hierarchical and integrated Models.

Mathematical Models

Mathematical Models and their importance in biomedical engineering. Compartmental modelling. Deterministic and Stochastic models and their applications of: (a) Electrical and fluidic modelling of the blood flow through the artery, (b) Elementary Vascular Model and Its Electrical Analog, (c) Electrical modelling of physiological System, (d) Electrode electrolyte interface model, and (e) Hodgkin–Huxley model for cell action potentials

Application of Modelling and Simulation in Physiological System

Examples of Physiological models. Medical imaging and its importance in modelling and Simulation. Mathematical techniques for modelling and simulation including: (i) Modelling of human organs using 3D printing, (ii) Thermal modeling and their applications using Bio heat equations, and (iii) Factors effecting thermal models.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Explain** Mathematical modelling, its types and the various simulation procedures and how they are used to obtain approximate solutions to dynamic problems in Biomedical Engineering	C2	1
2	**Organize** the procedures of discrete and continuous time simulations to infer meaningful insights and their impact on real-life scenarios and applications.	A4	6
3	**Analyze** Monte Carlo Simulation and Cellular Automata and be able to EXAMINE Network and Agent based models	C4	4
4	**Apply** modelling and simulation to Real-World Events, physiological, electrical, mechanical problems and find solutions of linear and nonlinear equations and the solution of differential equations in life sciences.	P2	10

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **MG-257 Organizational Behaviour**	SEMESTER ■ SPRING ☐ FALL	CREDIT HOURS TH ☐3 ■2 ☐1 ☐0 PR ☐3 ☐2 ☐1 ■0
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-12 Responsible Consumption and Production
SDG-13 Climate Action

COURSE CONTENTS

Introduction to Organizational Behaviour

Foundations of OB: Management Functions, roles, and skills; Effective versus successful managerial activities; Replacing intuition with systematic study, Exploring OB challenges and opportunities facing globalization, OB Model

Foundations of Individual Behaviour

Biographical traits and ability, Personality, Perceptions and individual decision making, Values, attitudes, and job satisfaction, Motivation – basic concepts and applications, Work stress

Foundations of Group Behaviour

Group in OB, Defining and classifying groups, Stages of group development, work group behaviour, dynamics of groups, Understanding work teams, Leadership: basic approaches and contemporary issues; Conflict & negotiation

Foundations of Organizational Structure

Organizational structure and design, Organizational culture, Organizational change and development

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
1	**Discuss** key organizational behavior concepts and its implications in engineering profession.	C2	11
2	**Apply** organizational behavior skills with reference to engineering profession	C3	6

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **MG-485 Entrepreneurship**	SEMESTER **■ SPRING □ FALL**	CREDIT HOURS **TH □3 ■2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **26 MAY 2025**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDD-05 Gender Equality
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction to Entrepreneurship

The concept of entrepreneurship, entrepreneurial mindset, social entrepreneurship, and essential entrepreneurial skills;

Initiating entrepreneurial ventures

innovation and creativity, assessment of entrepreneurial opportunities, pathways to entrepreneurial ventures, sources of capital;

Developing the entrepreneurial plan

legal challenges, marketing challenges, financial planning, export orientation, developing an effective business plan;

Growth strategies

strategic entrepreneurial growth through scaling, valuation of entrepreneurial ventures, and harvesting the entrepreneurial venture

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Discuss** key concepts and their implications for business ethics on entrepreneurial activities.	C2	11
2	**Demonstrate** the entrepreneurial skills to develop a business plan.	C3	8

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-422 Biotechnology**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction

History; foundation of modern biotechnology; current and future concerns.

Gene Expression

Understanding and exploiting gene expression.

Basic Principles of Recombinant DNA Technology

Cutting and joining DNA; cell transformation; cloning vectors; constructing and screening DNA library; protein methods.

Microbial Biotechnology

Commercial production of microorganisms (industrial, fermental and single cell protein); bioconversions; microorganism and agriculture; products from microorganisms (metabolites enzymes, antibiotics, fuels, plastics); bioremediation; microorganism and future.

Plant Biotechnology

Plant tissue culture and applications (micropropagation somatic embryogenesis, soma clonal variation, valuable germplasm, genetically engineered plants); application of plant genetic engineering (crop improvement; herbicide resistance; insect and viruses' resistance; plant as bioreactors).

Animal Biotechnology

Gene transfer methods in animals; transgenic animals; animal diseases.

Marine Biotechnology

Marine natural products and their medical potential; anti-cancer and anti-viral compounds.

Current Scenarios in Biotechnology

The emerging field of biotechnology; equipment of biotechnology; the current scenario in biotechnology (e.g. cloning, gene therapy, synthetic drug, synthetic DNA, antibody engineering).

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** ethical principles and professional responsibilities associated with biotechnological research and applications.	C2	7
2	**Analyze** experimental scenarios in biotechnology to evaluate team-based lab performance, collaboration effectiveness, and problem-solving strategies.	C4	1
3	**Demonstrate** responsible use of biotechnological methods in preventive, diagnostic, or therapeutic procedures while adhering to professional ethics.	P2	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-423 Introduction to Robotics**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) None	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Fundamentals of Robotics

Classification of Robots; History of Robotics; Advantages and Disadvantages of Robots; Robot Components; Degrees of Freedom; Robot Configurations; Robot Applications.

Robot Kinematics and Inverse Kinematics

Robots as Mechanisms; Homogeneous Transformation Matrices; Forward and Inverse Kinematics of Robots; Denavit-Hartenberg Representation of Forward Kinematic; Inverse Kinematic Solution of Robots; Dexterity.

Differential Motions and Velocities

Differential Relationships; Differential Motions of a Frame; Interpretation of the Differential Change; Differential Changes Between Frames; Differential Motions of a Robot and Its Hand Frame; Calculation of the Jacobian; How to Relate the Jacobian and the Differential Operator; Inverse Jacobian.

Dynamic Analysis and Forces

Lagrangian Mechanics A Short Overview; Dynamic Equations for Multiple-Degree-of-Freedom Robots; Static Force Analysis of Robots; Transformation of Forces and Moments Between Coordinate Frames.

Trajectory Planning

Path vs. Trajectory; Joint-Space vs. Cartesian-Space Descriptions; Basics of Trajectory; Joint-Space Trajectory Planning; Cartesian-Space Trajectories; Continuous Trajectory Recording.

Sensors and Actuators

Sensor Characteristics; Position Sensors; Velocity Sensors; Acceleration Sensors; Force and Pressure Sensors; Light and Infrared sensors; Touch and Tactile Sensors. Characteristics of Actuating Systems; Comparison of Actuating Systems; Hydraulic Devices; Pneumatic Devices; Electric Motors; Microprocessor Control of Electric motors; Speed Reduction.

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Image Processing and Analysis with Vision Systems

Image Processing versus Image Analysis; Frequency Domain vs. Spatial Domain; Fourier Transform of a Signal and its Frequency Content; Frequency Content of an Image; Noise, Edges; Image-Processing Techniques Histogram of Images; Thresholding; Noise; Edge Detection; Hough Transform; Segmentation; Segmentation by Region Growing and Region Splitting; Image Analysis; Object Recognition by Features; Depth Measurement with Vision Systems.

Fuzzy Logic Control

Fuzzy Control; Crisp Values vs. Fuzzy Values; Fuzzy Sets Degrees of Membership and Truth; Fuzzification; Fuzzy Inference Rule Base; Defuzzification; Applications of Fuzzy Logic in Robotics.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Interpret** ethical frameworks and professional standards governing the design, deployment, and societal integration of robotic technologies in healthcare.	C2	7
2	**Analyze** robotic systems by integrating principles of control theory, biomechanics, and sensor feedback to evaluate their operational performance.	C4	1
3	**Operate** and **Optimize** robotic systems for assistive or rehabilitation tasks, incorporating user safety, technical precision, and professional responsibility in all stages of practical implementation.	P2	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-429 Tissue Engineering**	SEMESTER □ SPRING □FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Quantitative cell and tissue biology; tissue organization; components; types; functional subunit; problem decomposition.

Dynamics states of tissue; homeostasis in highly prolific tissues; tissue repair; tissue dynamics and interacting cellular-fate processes.

Morphogenesis: Processes; dynamics and constraints.

Basic concepts; examples of stem cell systems; dynamic function of stem cell systems.

Cell differentiation; division; death and dynamics; soluble signals; cell-extracellular matrix interaction; direct cell-cell contact; response to mechanical stimuli; interaction between signaling mechanism.

Basic tools; measurement of cell characteristic; measurement of tissue; history and types of tissue culture; media; cultural environment of cell in vitro; cell function in tissue culture; cryopreservation; contaminants.

Methods; retro-virally mediated gene delivery processes; transfer for modifying cellular functions.

Engineering Methods and Design: Time constant; simplifying dynamic description.

Using in-vivo conditions as a guide; key design challenges; fluid flow; cellularity; geometry of the microenvironment.

Basic characterization and practice cell separation methods; biomaterials scaffolds; biomaterials properties and types; tailoring of biomaterials.

Conventional approach to tissue dysfunction and its medical and surgical therapies; repair, replacement of tissues; temporary support during extracorporeal devices; tissue engineered therapies; wound healing response; angiogenesis and immune response.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Product characterization; preservation; pattern protection; regulation of tissue engineered products and ethical issues.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Explain** ethical considerations and safe laboratory practices when working with tissue engineering tools and biomaterials.	C2	7
2	**Analyze** the core concepts of tissue engineering to assess current biomedical applications, challenges, and future directions.	C4	1
3	**Demonstrate** the operation and performance evaluation of tissue scaffold and bioreactor systems in a collaborative lab setting.	P2	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-430 Rehabilitation Engineering**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction

Introduction to rehabilitation engineering and assistive technology (AT); telerehabilitation; future of rehabilitation engineering.

Limb Prosthetic Devices

Classification of amputation; prosthetic prescription and fabrication; components of upper limb prosthesis; components of lower limb prosthesis.

Orthotic Devices

Introduction; biomechanical principles of orthoses; design consideration; spinal orthoses; limb orthoses.

Devices for Visually Impaired

Dimensions of visual impairment and their impact on task performance; general purpose assistive technology solutions; task-specific assistive technologies; technology for reading; writing and graphic access.

Devices for Hearing Impairment

Types of hearing impairment; historical overview of HAT (Hearing assistance technology); medical and surgical approaches to restoring hearing function; assistive listening devices solutions; environmental adaptations and universal designs.

Wheelchairs

Manual wheelchairs and electrical power wheelchairs with brief history;user profiles; basic structural components;power and drive systems; control system; power assisted wheelchairs; multifunctional wheelchairs; wheelchair standards.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Describe** the ethical considerations and foundational principles related to functional disabilities involving sensory, motor, and cognitive systems.	C2	7
2	**Evaluate** assistive technology needs and propose inclusive design approaches to address disability-related challenges.	C4	1
3	**Perform** the safe and effective use of assistive devices in a laboratory environment, demonstrating teamwork and adherence to ethical standards.	P2	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-432 Neuroscience & Neural Networks**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Introduction to neuroscience

Nervous system, sympathetic, parasympathetic, and motor nervous system and their functions, brain, and its functions. Neurons and glia, structure of a neuronal cell, types of glia, blood brain barriers.

Signaling in the brain

Electrical excitability of neurons, resting membrane potential, action potential. Intra neuronal singling, inter neuronal singling. Synaptic events, chemical messengers, synaptic transmission.

Receptors

Ionotropic and metabotropic receptors, signal transduction pathways, G-proteins, protein phosphorylation. Signaling to the nucleus, regulation of gene expression

Neurotransmitters

Excitatory and inhibitory amino acid neurotransmitters and functions in the brain, role of excitatory neurotransmitter in learning and memory. Diseases associated with the malfunctioning of these neurotransmitters.

Catecholamines

Functions in the brain, Diseases associated with the malfunctioning.

Artificial Neural Networks

Model of single neuron, neural network architectures. Feed forward neural networks. Multilayer perception, back propagation algorithm, radial basis function networks. Unsupervised learning. Hopfield network, self-organizing map, other unsupervised networks. Reinforcement learning.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Identify** the structure and function of neural systems relevant to sensory, motor, and cognitive control and relate them to ethical medical engineering practice.	C2	7
2	**Interpret** and **analyze** neuroscience datasets to evaluate experimental methodologies and validate findings using engineering principles.	C4	1
3	**Use** lab-based instrumentation and software to collect and process neurophysiological data while collaborating effectively in a team environment.	P2	8

REMARKS (if any):

Recommended by: _____ (Chairperson/Date)

Approved by: _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-307 Bioinformatics**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH □3 ■2 □1 □0 PR □3 □2 ■1 □0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-09 Industry Innovation and Infrastructure
SDG-10 Reduced Inequalities

COURSE CONTENTS

Review

Molecular biology and genetics. Introduction to Biological Databases

Introduction to bioinformatics; goals; scope and applications; types of characteristics of databases; information retrieval system.

Sequence Alignment

Why align sequence? evolutionary basis; sequence homology; similarity and identity; database similarity searching; heuristic approach; FASTA and BLAST; multiple sequence alignment; scoring function; various algorithm; Markov and Hidden Markov models; protein motif and domain prediction.

Gene and Promoter Predication

Gene predication in prokaryotes and eukaryotes; promoters and regulatory elements and prediction in prokaryotes and eukaryotes; predication algorithms.

Molecular Phylogenetic

Molecular evolution and molecular phylogenetic; gene and species phylogeny; tree representation.

Structural Bioinformatics

Protein structure basics; protein structure visualization; comparison and classification; secondary and tertiary; quaternary structures; RNA structure prediction.

Genomics and Proteomics

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

Genome mapping; sequencing; assembly annotation and comparison; functional genomics; sequence-based approaches; micro array bases approaches; protein expression analysis; protein sorting; protein-protein interaction.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Interpret** human genomic information with an emphasis on ethical decision-making, patient confidentiality, and responsible data handling in medical contexts.	C2	7
2	**Develop** strategies to integrate genomic insights into health diagnostics and treatment planning through interdisciplinary collaboration.	C4	1
3	**Operate** bioinformatics tools and laboratory instruments to collect and analyze genetic data following safety protocols.	P2	8

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-436 Digital Transformation**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction to Digital Transformation

Definition, scope, and importance of digital transformation in healthcare; digitalization trends and their impact on societies; evolution of biomedical engineering with digital technologies.

Digital Transformation in Medical Devices

Role of artificial intelligence in medical devices; activity tracking devices; implants; bionics and robotics devices; the future frontiers of artificial intelligence in medical devices; remote patient monitoring system: sensors, smartphones, apps, and devices.

Smart Hospital Systems

Patient verification systems; intensive medical care area management system; electronic health records.

Holographic Technology

Introduction to holographic technology; Augmented reality; virtual reality; holograms for the medical industry; role of holographic operation theatres.

Role of Robots in Digitalization

Overview of robotic surgeries; da Vinci system for head and neck surgery; the flex robotic system.

Digital Design and Manufacturing

Digitalization in material manufacturing; 3D printing.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Identify** key concepts, technologies, and terminologies involved in the digital transformation of healthcare and biomedical engineering.	C1	1
2	**Explain** the societal, ethical, and environmental impacts of digitalization in healthcare technologies such as smart hospitals, AI, and robotics.	C2	6
3	**Discuss** the importance of continuous learning and adaptability in emerging digital healthcare technologies including 3D printing, AR/VR, and AI-driven systems.	C2	11

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-437 Computer Aided Diagnostics**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **26 MAY 2025**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction to Computer Aided Diagnostics (CAD) systems

Computer aided diagnostics and its applications in healthcare industry; benefits and limitations of CAD systems; ethical considerations and regulatory aspects of CAD.

Image foundation and processing

Image acquisition modalities; image noise and artifacts; image processing techniques; types of features in medical images; feature extraction techniques; feature selection; importance of feature selection; methods for feature selection.

3D medical image analysis

Cancer detection; cardiovascular diseases detection; brain disorder; respiratory diseases.

Computer aided Pathology and Automation in Clinical Laboratories

Definition and evolution from traditional microscopy; telepathology and remote diagnostics; laboratory information management system.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Recall** the fundamental concepts, components, and clinical applications of Computer Aided Diagnostic (CAD) systems in the healthcare industry.	C1	1

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

2	**Explain** the ethical, societal, and clinical implications of CAD systems, including issues of data privacy, automation in diagnostics, and regulatory challenges.	C2	6
3	**Discuss** the evolving role of CAD technologies and the importance of continuous learning to adapt to innovations in medical imaging and laboratory automation.	C2	11

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-421 Genetic Engineering**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Defining the purview of genetic engineering

Tools and techniques Properties and applications of DNA Modifying Enzymes: Host controlled restriction modification system (Nomenclature, Type I-IV restriction endonucleases, Isoschizomers); DNA Methyltransferases; DNA polymerases; Special case of thermo-stable DNA polymerases in context to PCR (History, concept, enzymology, applications); Reverse transcriptase in context to semi-quantitative and quantitative RT-PCR.

Introduction to cloning

Generalized cloning schemes, host genotypes specificities and applications, strategies for selection and screening (Introduction to marker and reporter genes, positive and negative selection, insertion inactivation, α complementation).

Types of vectors

Plasmids; Lambda based vectors and derivatives (Insertion vectors, replacement vectors, cosmids, phasmids, phagemids, in-vitro packaging, selection schemes); high-cloning capacity vectors: single stranded DNA vectors (M13, fd, f1); YACs, BACs, PACs, BIBACs, Plant Transformation vectors Ti, Ri plasmids, Binary, Conjugate, selection schemes), Protein Expression Vectors (expression systems for high level protein expression in E.coli and yeast, transcriptional efficiency, inducible promoters, translational efficiency, translational initiation, elongation, codon usage), protein extraction and purification (protein purification tags, histidine and GST tags, IMAC).

Genomic DNA libraries

(Procedures for Partial, Representative, Enriched, Large- 4 insert DNA libraries in context to medium and high-capacity cloning vectors) cDNA libraries (Self-priming methods, replacement synthesis, Okayama and Berg strategy, use of Adapters/Linkers and methylation for directional cloning).

Site-Directed Mutagenesis

PCR based methods for site-directed mutagenesis (Single primer methods viz. Mis-incorporation of mismatched oligos, Over-lap extension), whole plasmid single round PCR), mis-repair of mutant oligonucleotides, selection of mutant

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

(dut/ung E. coli strains for SDM through uracil replacement), Ligase chain reaction. In-silico analysis, manipulation and annotation of DNA sequences for experimental design and efficient management of cloning experiments.

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Understand** the concept of genetic engineering including the techniques, applications and limitations in basic and applied experimental biology.	C1	1
2	**Describe** the methods of screening and cloning strategies for recombinant DNA in biotechnological research.	C2	11
3	**Recognize** versatile techniques for designing recombinant molecules and apply learned knowledge to solve problems.	C2	6

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-424 Fluid Dynamics**	SEMESTER □SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	**DATE OF COURSE CONTENT APPROVAL** **18 SEPTEMBER 2018**	**APPLIED FROM BATCH** **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Review

Basic equations; compressible, incompressible flows; Navier-Stokes equations; slip and no-slip conditions; shear driven flows (Couette, Poiseuille, cavity flows).

Biofluid Flow Systems

Biofluid flow systems; physiological fluid dynamics; flow through arteries and veins; micro flows and their relevance in nature and technology; micro-fluidic devices in life sciences; low Reynolds number effects.

Computational Fluid Dynamics

Introduction to modern computational fluid dynamics; finite difference and finite volume methods; grid generation; explicit, implicit, and iterative techniques; solutions of elliptic, parabolic, and hyperbolic equations; emphasis on applications.

CFD Commercial Software (e.g FLUENT)

GAMBIT Tutorials – geometry and grid generation; CFD codes; assessing accuracy of numerical solutions – verification and validation; use of FLUENT – basic issues, model development, post processing; mathematical models; Navier-Stokes equations; computational grids – advanced topics.

Benchmark Problems and Case Studies

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Define** the elementary concepts of fluid dynamics.	C1	1
2	**Explain** the understanding by applying mathematical models to simple realizable configurations along with practical considerations.	C2	6
3	**Explain** the use of computational fluid dynamic tool for the applications/solutions of models developed for biomedical applications.	C2	11

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-425 Telemedicine**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Information technology and Healthcare professionals.

Overview of Telemedicine.

Communications Networks and Services.

Use of computers in distance mode of healthcare delivery; Web technology; Satellite communication systems.

Wireless communications. Basics and types of wireless networks (Bluetooth, IR, WLAN, GSM etc.). Role of Wireless technology in patient monitoring.

Body Area Network, Emergency rescue, Remote recovery, In patient Monitoring Technologies in Medical Information Processing.

Collecting data from patients; Data compression and Transfer; Capturing of medical signals; Analog to digital conversion; Bio-signal transmission and processing.

Electronic Drug Store.

Telemedicine system development and deployment IT in alternative medicines.

Future trend in Telemedicine Technology.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Understand** the types and forms of telemedicine, the main applications of telemedicine and telehealth and how these have evolved over time	C1	1
2	**Describe** the incorporation and impact of telemedicine on quality health care delivery, and with evolving telecommunication improving the patient experience.	C2	11
3	**Understand** the often complex legal, regulatory, accountability and reimbursement issues surrounding telehealth and RECOGNIZE the value of understanding users and contexts for effective telehealth design, and how to achieve this.	C2	6

REMARKS (if any)

Recommended by _____

(Chairperson/Date)

Approved by _____

(Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE CODE & TITLE **BM-435 Biophysics**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction; physics, statistics, and sight

What are the fundamental limits on vision, and how close does biology come to reaching them

Components of biological systems

What are the components of biological systems? What is the length, time, and energy scales? How can we organize a large list of "parts?"

Probability and heredity (a quick look)

Concepts in probability and statistics., quantitative understanding of probability revealed how inheritance and mutation are related.

Random walks

Array of biophysical processes, from the diffusion of molecules to the swimming strategies of bacteria to the conformations of biomolecules, by understanding the properties of random walks.

Life at low Reynolds number

Why bacteria swim, and why they don't swim like whales. Entropy, energy, and electrostatics, how entropy governs electrostatics in water, the "melting" of DNA, phase transitions in membranes, and more.

Mechanics in the cell

Mechanical properties of DNA, membranes, and other cellular components

Circuits in the cell

Cells sense their environment and perform computations using data they collect. How can cells build switches, memory elements, and oscillators? What physical principles govern these circuits?

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Understand** the models of biological systems and models dealing with statistical mechanics and transport phenomena.	C1	1
2	**Integrate** information provided from all physical tools and processes to analyze biological processes.	C2	11
3	**Explain** methods for solving qualitative and quantitative problems, using appropriate statistical mechanics and computing techniques.	C2	6

REMARKS (if any)

Recommended by _____ (Chairperson/Date)

Approved by _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-426 Ergonomics**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Overview of Ergonomics

Introduction to ergonomics and its scope in relation to work. Outline of the disciplines of anatomy, physiology and psychology, with respect to ergonomics building blocks such as anthropometry and biomechanics.

Ergonomics Methods and Techniques

Observational experimental methods are identified which can be used for investigation, so that work, equipment and planned systems can be improved for human use.

Musculoskeletal Disorders

The disorders resulting from manual handling and repetitive work must be covered and the causes explained. The methods of assessment and the techniques used to prevent or reduce these disorders must also be covered.

Workplace, Job and Product Design

Key features in the design of workplaces, jobs and their results - products and services - are outlined, so that more effective and healthier work can be achieved. Existing data and routes to further sources of information are emphasized.

Relevant Physical Factors of the Work Environment

Physical factors of the working environment must include the way the eye, ear and clothed body respond qualitatively to light, sound heat etc., so that human performance can be predicted and improved. This part of the syllabus should be regarded as an overview and thus technical and quantitative detail should be minimized.

Standards and Social Aspects

Consideration should be given to sources of standards covering ergonomics, social aspects and training, instruction and supervision requirements.

NED University of Engineering and Technology

Department of Biomedical Engineering

Bachelor of Engineering (Biomedical)

Course Profile

F/QSP 11/17/01

COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Understand** ergonomics principles for the creation of a safer, healthier and more efficient workplace	C1	1
2	**Explain** the understanding by applying ergonomics principles to the design of workplace layout and design or selection of equipment	C2	6
3	**Explain** appropriate risk reduction measures to reduce ergonomic risks and discuss environmental aspects of good ergonomic design.	C2	11

REMARKS (if any):

Recommended by _____ (Chairperson/Date)

Approved by _____ (Dean/Date)

NED University of Engineering and Technology

Department of Biomedical Engineering
Bachelor of Engineering (Biomedical)

F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE **BM-427 Product Design in Biomedical Engineering**	SEMESTER □ SPRING □ FALL	CREDIT HOURS TH ■3 □2 □1 □0 PR □3 □2 □1 ■0
PREREQUISITE COURSE(S) **None**	DATE OF COURSE CONTENT APPROVAL **18 SEPTEMBER 2018**	APPLIED FROM BATCH **2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Introduction

Medical device as an entity; brief history of medical devices; current medical devices; Food and Drug Administration; Medical Device Directives.

Medical Devices Specifying the Product

Product definition process; QFD; business proposal; Requirement engineering; product specification; design specification; software requirements specification; safety and risk management; liability; Patents; copyrights; trademarks; trade secrets.

Product Designing

Six sigma and product design; methodologies; robust design; Hardware design; software design; software coding; Human factors design considerations.

Reliability

Historical perspective; quality vs. reliability; concept of failure; causes of failure; practical aspects of failure; hardware and software failure; failure due to human error.

Regulations and Standards

History of device regulations; FDA; device classification; registrations and listing; pre-market approvals; Investigation device exemptions (IDEs); Medical Devices Directives (MDD); application of CE mark; quality system regulation; Domestic and International standards.

Testing and Data Analysis

Types of testing; testing protocols and methodologies; Hardware and software verification and validation; Analysis of test results.

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Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to:			
1	**Learn** the product development process for medical devices in industrial context	C1	1
2	**Explain** the regulatory approval process and key regulatory agencies (FDA, MDD, ISO etc.) for medical devices	C2	6
3	**Establish** product requirements, safety, and risk analysis, liability	C2	11

REMARKS (if any):

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)

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F/QSP 11/17/01

Course Profile

COURSE CODE & TITLE	SEMESTER	CREDIT HOURS
BM-431 Biophotonics	**□ SPRING □ FALL**	**TH ■3 □2 □1 □0** **PR □3 □2 □1 ■0**
PREREQUISITE COURSE(S)	**DATE OF COURSE CONTENT APPROVAL**	**APPLIED FROM BATCH**
None	**18 SEPTEMBER 2018**	**2025**

MAPPED SUSTAINABLE DEVELOPMENT GOAL(s) (SDG(s))

SDG-03 Good Health and Well Being
SDG-09 Industry Innovation and Infrastructure

COURSE CONTENTS

Overview of Biophotonics

Biology and Biophotonics, Medicine/Clinics and Biophotonics

Types of Optics

Geometric optics, wave optics, radiometry and fiber optics

Lasers

Gas Lasers, Diode Lasers, Solid state Lasers, Fiber lasers, Ultrafast lasers, Ultrachrome lasers.

Optical instrumentation

Microscope, grating spectrometer, Optical properties of tissue - absorption and scattering, Beer's law, optical phase function, spectroscopy, Diffusion approximation, Applications of diffusion, Fluorescence spectroscopy, Confocal microscopy, Fiber optic sensors.

Diagnosing diseases with light

Endoscopy, Optical coherence tomography (OCT): Application to ophthalmology, Photoacoustic tomography: Application to early cancer detection

Treatment of diseases with light

Killing cancer cells with light: Photodynamic therapy, Tissue engineering with light

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COURSE LEARNING OUTCOME AND ITS MAPPING WITH PROGRAMME LEARNING OUTCOME

Sr. No.	CLOs	Taxonomy level	Programme learning outcome (PLO)
At the end of the course, the student will be able to			
1	**Understand** the basics of microscopy and optical bioimaging and the main concepts involved in the interaction of optical radiation with biological tissues	C1	1
2	**Describe** the strengths and limitations of modern techniques in microscopy and DISCUSS the main applications of biophotonics.	C2	11
3	**Explain** a particular bio photonics technique to solve the problems at the interface of engineering and biology.	C2	6

REMARKS (if any)

Recommended by _____ **Approved by** _____

(Chairperson/Date) (Dean/Date)