CENTRAL UNIVERSITY OF PUNJAB
BATHINDA

Ph.D. in Pharmaceutical Sciences

(Pharmacology)

PH-MPL-F

Batch-2022

Department of Pharmacology

Graduate Attributes:

At the end of the course student should be able to acquire sound knowledge of general pharmacological principles, systemic pharmacology and rational use of drugs, plan and conduct lecture, practical demonstration and tutorial classes of pharmacology and allied sciences, carry out screening of drugs for pharmacological and toxicological profile, critically review and comment on research papers, preparation of protocols to conduct experimental studies in animals and human drug trials independently.

SEMESTER 1 (Course Work)

S. No.	Course code	Course Title	L	T	P	Cr
1	PPL.701	Research Methodology & Biostatistics	4	0	0	4
2	PPL.702	Computer Applications	2	0	0	2
3	PPL.751	Research and Publication Ethics	2	0	0	2
4	PPL.752	Teaching Assistantship	0	0	2	1
5	UNI.753	Curriculum, Pedagogy and Evaluation	1	0	0	1
*Opt any ONE of the following courses						
5	PPL.705	Recent advances and new drug targets in neurological disorders	4	0	0	4
6	PPL.706	Recent advancement and new drug targets in Endocrine disorder	4	0	0	4
7	PPL.707	Movement and Cognitive Disorders: From Basic to Recent advances	4	0	0	4
		Total	13	0	2	14

E: Total Marks
  L: Lectures   T: Tutorial   P: Practical   Cr: Credits

Criteria of Evaluation:
End Term Examination: Subjective Type Test [100 Marks]

Course Title: Research Methodology & Biostatistics

Paper Code: PPL.701

Total Hours: 60hrs

Course Learning Outcomes

CLO 1:   Select and define an appropriate research problem and parameter
CLO 2:   Design and set the objectives based on the literature search.
CLO 3:   Protect the research work through patent or copyright or trademarks
CLO 4:   Learn technical and scientific writing skills
CLO 5:   Learn presentation skills
CLO 6:   Learn basic descriptive and inferential statistics, including the concepts and principles of research design and statistical inference
CLO 7:   Perform and interpret descriptive and inferential statistical techniques, including the construction of tables and graphs, t-tests, Chi-square tests, and regression analysis. Use appropriate software packages to solve analytical problems

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/15hr	**General principles of research:** Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion. **Intellectual Property Rights:** Intellectual Property, intellectual property protection (IPP) and intellectual property rights (IPR), WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade-Related Intellectual Property Rights), TRIMS (Trade-Related Investment Measures) and GATS (General Agreement on Trades in Services), Nuts and Bolts of Patenting, Technology Development/Transfer Commercialization Related Aspects, Ethics and Values in IP.	**CLO 1** **CLO 2** **CLO 3**
Unit-2/15hr	**Technical writing:** Technical & Scientific writing - theses, technical papers, reviews, electronic communication, research papers, etc., Poster preparation and Presentation and Dissertation. Reference Management using various softwares such as Endnote, reference manager, Refworks, etc. Communication skills – defining communication; type of communication; technicques of communication, etc. Library: Classification systems, e-Library, Reference management, Web-based literature search engines	**CLO 4** **CLO 5**
Unit-3/15hr	**Descriptive Statistics:** Meaning, need and importance of statistics. Attributes and variables. Measurement and measurement scales. Collection and tabulation of data. Diagrammatic representation of frequency distribution: histogram, stem and leaf plot, pie chart.	**CLO 6**

		Measures: Measures of central tendency, dispersion (including box and whisker plot), skewness and kurtosis. Linear regression and correlation (Karl Pearson's and Spearman's) and residual plots.	
Unit-4/15hr		**Discrete and continuous random variables.** Discrete Probability distributions like Binomial, Poisson and continuous distributions like Normal, F and student-t distribution. Differences between parametric and non-parametric statistics. Confidence interval, Errors, Levels of significance, Hypothesis testing **Parametric tests:** Test for parameters of Normal population (one sample and two sample problems) z-test, student's t-test, F and chi-square test and Analysis of Variance (ANOVA). **Non-Parametric tests:** One sample: Sign test, signed-rank test, Kolmogrov-Smirnov test, run test, Kruskal–Wallis one-way ANOVA by ranks, Friedman two-way ANOVA by ranks.	**CLO 7**

Suggested Readings:

1. Saha, Indranil & Paul, Bobby. (2020). ESSENTIALS OF BIOSTATISTICS & RESEARCH METHODOLOGY - 3rd Edition.
2. Creswell, D., Creswell, J. W. (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications, Inc.
3. Gupta, S. (2008). Research methodology and statistical techniques. New Delhi: Deep & Deep Publications (p) Ltd.
4. Kothari, C. R. (2008.) Research methodology(s). New Delhi: New Age International (p) Limited.
5. Best J. W., Khan J. V., Jha, A.K. (2014). Research in Education. India: Pearson Education India.
6. National Research Council. (2014). Safe science: promoting a culture of safety in academic chemical research. Washington DC: National Academic Press.
7. Copyright Protection in India [website: http:copyright.gov.in].
8. World Trade Organization [website: www.wto.org].
9. Wadedhra B.L. (2006). Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications. New Delhi: Universal Law Publishing.
10. Gookin, D. (2007). MS Word for Dummies. Hoboken, NJ: Wiley Publishing, Inc.
11. Harvey, G. (2007). MS Excel for Dummies. Hoboken, NJ: Wiley Publishing, Inc.
12. Sinha, P.K. and Sinha, P. (2017). Computer Fundamentals. BPB Publications
13. Norman, G. and Streiner, D. (2008). Biostatistics: The Bare Essentials.. Canada: Decker Inc.
14. Sokal, R.R. and Rohlf, F.J. (1994). Biometry: The Principles and Practices of Statistics in Biological Research, New York:W.H. Freeman and Company.
15. Bolton, S., & Bon, C. (2009). Pharmaceutical statistics: practical and clinical applications. Boca Raton: CRC Press.

The following are some of the modes **of classroom transaction**
1) Classroom Lecture
2) Demonstration
3) Lecture cum demonstration
4) Guest Lecture
5) Peer Group Discussion

IQAC

Course Title: Computer Applications

Course code: PPL.702

Total Hours: 30

Course Learning Outcomes

CLO 1: Use different operating system and their tools easily
CLO 2: Understand networking and internet concepts
CLO 3: Protect use of word   processing software
CLO 4: Understand presentation software and usage of spread sheet
CLO 5: Use computers in every field like teaching, industry and research

Unit/hr	Course Content	Course Learning Outcomes
Unit- **1/7hr**	**Computer Fundamentals:** Introduction to Computer, Input devices, Output Devices, Memory (Primary and Secondary), Concept of Hardware and Software, C.P.U., System bus, Motherboard, Ports and Interfaces, Expansion Cards, Ribbon Cables, Memory Chips, Processors, Software: Types of Software, Operating System, User Interface of popular Operating System, Introduction to programming language, Types of Computer	**CLO 1**
Unit- **2/7hr**	**Computer Network:** Introduction to Computer Network, Types of Network: LAN, WAN and MAN, Topologies of Network, Internet concept, WWW. **Word Processing**: Text creation and Manipulation; Table handling; Spell check, Hyper-linking, Creating Table of Contents and table of figures, Creating and tracking comments, language setting and thesaurus, Header and Footer, Mail Merge, Different views, Creating equations, Page setting, Printing, Shortcut keys.	**CLO 2** **CLO 3**
Unit- **3/8hr**	**Presentation Tool:** Creating Presentations, Presentation views, working on Slide Transition, Making Notes Pages and Handouts, Drawing and Working with Objects, Using Animations, Running and Controlling a Slide Show, Printing Presentations, and Shortcut keys. **Spread Sheet**: Entering and editing data in cell, Basic formulas and functions, deleting or inserting cells, deleting or inserting rows and columns, printing of Spread Sheet, Shortcut keys.	**CLO 4**
Unit- **4/8hr**	**Use of Computers in Education and Research**: Data analysis tools, e- Library, Search engines related to research, Research paper editing tools like Latex	**CLO 5**

Suggested Readings:

1. Goel, A., Ray, S. K. (2017). Computers: Basics and Applications. Pearson Education India
2. Microsoft Office Professional (2016). Step by Step https://ptgmedia.pearsoncmg.com/images/9780735699236/samplepages/9780735699236.pdf
3. Sinha, P.K. and Sinha, P. (2017). Computer Fundamentals. BPB Publications
4. Computer and Communication Networks, Nader F. Mir, Pearson Education, 2007

Transactional Modes:

Classroom Lecture
Demonstration
Lecture cum demonstration
Guest Lecture
Peer Group Discussion

Course Title: Research and Publication Ethics

Course code: PPL 751

Total Hours: 30hrs

Course Learning Outcomes
CLO 1: Basic knowledge of Ethics
CLO 2: Learn about the ethics to maintain scientific and research integrity
CLO 3: Understand publication ethics and identification of publication misconduct
CLO 4: Learn about various open access publications
CLO 5: Able to evaluate predatory publications and journals
CLO 6: Learn about the different databases, research engines and research metrics

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/3hr	**Philosophy and Ethics** Introduction to Philosophy: definition, nature and scope, content, branches Ethics: definition, moral philosophy, nature of moral judgements and reactions	**CLO 1**
Unit-2/5hr	**Scientific Conduct** Ethics with respect to science and research Intellectual honesty and research integrity Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data	**CLO 2**
Unit-3/7hr	**Publication Ethics:** Publication Ethics: definition, introduction and importance Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types Violation of publication ethics, authorship and contributorship Identification of publication misconduct, complaints and appeals Predatory publishers and journals	**CLO 3**
Unit-4/4hr	**Open Access Publishing** Open access publications and initiatives SHERPA/Ro MEO online resource to check publisher copyright & self-archiving policies Software tool to identify predatory publication developed by SPPU Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, Etc.	**CLO 4**
Unit-5/4hr	**Publication Misconduct** Group Discussions: Subject specific ethical issues, FFP, authorship; conflicts of interest; complaints and appeals: examples and fraud from India and abroad	**COL 5**

	Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools	
Unit-6/7hr	**Databases and Research Metrics** Databases: Indexing databases; Citation database: Web of Science, Scopus etc. Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics : h-index, g-index, i10 index, almetrics	**COL 6**

Suggested Readings:
1. Adil E. Shamoo; David B. Resnik, (2003). Responsible conduct of research, Oxford University Press,
2. Barbara H. Stanley; Joan E. Sieber; Gary B. Melton (1996). Research Ethics: A Psychological approach, University of Nebraska.
3. Ian Gregory, (2003). Textbook of Research Ethics- Theory and Practice, Continuum, London.
4. Paul Oliver, (2003). The student's guide to research ethics, Open University Press.

The following are some of the modes of classroom transaction
1) Classroom Lectures
2) Guest lectures
3) Group Discussions
4) Practical Sessions

Course Title: TEACHING ASSISTANTSHIP

L	T	P	Credit
0	0	2	1

Course Code: PPL.703

Total Hours: 30

Course Learning Outcomes:

At the end of this skill development course, the scholars shall be able to

CLO1: familiarize themselves with the pedagogical practices of effective class room delivery and knowledge evaluation system

CLO 2: manage large and small classes using appropriate pedagogical techniques for different types of content

Activities and Evaluation:

- The scholars shall attend Master degree classes of his/her supervisor to observe the various transaction modes that the supervisor follows in the class room delivery or transaction process one period per week.

- The scholars shall be assigned one period per week under the direct supervision of his/her supervisor to teach the Master degree students adopting appropriate teaching strategy(s).

- The scholars shall be involved in examination and evaluation system of the Master degree students such as preparation of questions, conduct of examination and preparation of results under the direction of the supervisor.

- At the end of the semester, the supervisor shall conduct an examination of teaching skills learned by the scholar as per the following **evaluation criteria**:

    - The scholars shall be given a topic relevant to the Master degree course of the current semester as his/her specialization to prepare lessons and deliver in the class room before the master degree students for one hour (45 minutes teaching + 15 minutes interaction).

    - The scholars shall be evaluated for a total of 50 marks comprising *content knowledge* (10 marks), *explanation and demonstration skills* (10 marks), *communication skills* (10 marks), *teaching techniques employed* (10 marks), and classroom interactions (10).

Course Title: CURRICULUM, PEDAGOGY AND EVALUATION

Course Code: **UNI 753**

Total Hours: 15

Course Learning Outcomes

CLO 1: Analyze the principles and bases of curriculum design and development

CLO 2: Examine the processes involved in curriculum development

CLO 3: Develop the skills of adopting innovative pedagogies and conducting students' assessment

CLO 4: Develop curriculum of a specific course/programme

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/4hr	**Bases and Principles of Curriculum** 1. Curriculum: Concept and Principles of curriculum development, Foundations of Curriculum Development. 2. Types of Curriculum Designs- Subject centered, learner centered, experience centered and core curriculum. Designing local, national, regional and global specific curriculum. Choice Based Credit System and its implementation	**CLO 1**
Unit-2/4hr	**Curriculum Development** 1. Process of Curriculum Development: Formulation of graduate attributes, course/learning outcomes, content selection, organization of content and learning experiences, transaction process. 2. Comparison among Interdisciplinary, multidisciplinary and trans- disciplinary approaches to curriculum.	**CLO 2**
Unit-3/3hr	**Curriculum and Pedagogy** 1. Conceptual understanding of Pedagogy. 2. Pedagogies: Peeragogy, Cybergogy and Heutagogy with special emphasis on Blended learning, Flipped learning, Dialogue, cooperative and collaborative learning 3. Three e- techniques: Moodle, Edmodo, Google classroom	**CLO 3**
Unit-4/4hr	**Learners' Assessment** 1. Assessment Preparation: Concept, purpose, and principles of preparing objective and subjective questions. 2. Conducting Assessment: Modes of conducting assessment – offline and online; use of ICT in conducting assessments. 3. Evaluation: Formative and Summative assessments, Outcome based assessment, and scoring criteria.	**CLO 4**

Transaction Mode

Lecture, dialogue
Peer group discussion
Workshop

Evaluation criteria

There shall be an end term evaluation of the course for 50 marks for duration of 2 hours.
The course coordinator shall conduct the evaluation.

Suggested Readings

Allyn, B., Beane, J. A., Conrad, E. P., & Samuel J. A., (1986).
Curriculum Planning and Development. Boston: Allyn & Bacon.
Brady, L. (1995). Curriculum Development. Prentice Hall: Delhi. National Council of
Educational Research and Training.
Bhatia, S.K., Jindal, S. (2016). A TEXT BOOK OF CURRICULUM, PEDAGOGY AND
EVALUATION
Deng, Z. (2007). Knowing the subject matter of science curriculum, Journal of Curriculum
Studies, 39(5), 503-535.
Gronlund, N. E. & Linn, R. L. (2003). Measurement and Assessment in teaching. Singapore:
Pearson Education
McNeil, J. D. (1990). Curriculum: A Comprehensive Introduction, London: Scott,
Foreman/Little
Nehru, R. S. S. (2015). Principles of Curriculum. New Delhi: APH Publishing Corporation.
Oliva, P. F. (2001). Developing the curriculum (Fifth Ed.). New York, NY: Longman
Stein, J. and Graham, C. (2014). Essentials for Blended Learning: A Standards-Based Guide.
New York, NY: Routledge.

Web Resources
- https://www.westernsydney.edu.au/ data/assets/pdf_file/0004/46 7095/Fundamentals_of_Blended_Learning.pdf
- https://www.uhd.edu/academics/university-college/centers- offices/teaching-learning-excellence/Pages/Principles-of-a-Flipped- Classroom.aspx
- http://leerwegdialoog.nl/wp-content/uploads/2018/06/180621- Article-The-Basic-Principles-of-Dialogue-by-Renate-van-der-Veen-and- Olga-Plokhooij.pdf

Course Title: Recent advances and new drug targets in neurological disorders

Course Code: PPL-705

Total Hours: 60hrs

Course Learning Outcomes

CLO 1: Understand the complex pathophysiology of neurological disorders such as Stress, Anxiety, Depression, Brain stroke and its complications
CLO 2: Understand different behavioral changes seen after brain stroke, risk factors, diagnosis, and therapeutics for brain stroke.
CLO 3: Role of different neuropeptides and kinases in stress and related disorder
CLO 4: Generate idea of research in term of new key targets identification

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/15hr	General introduction of neurological disorders including stress, anxiety and depression. Pathophysiology of stress, anxiety, depression and post traumatic stress disorder. Neurobiology of stress adaptation. Compensatory mechanism of HPA axis in regulation of stress and anxiety	**CLO 1**
Unit-2/15hr	Role of different hormones and protein kinases in stress and depression stress and depression. Emerging or novel therapeutic targets drugs for the treatment of stress, anxiety and depression. Recent treatments for the management of Stress, Anxiety and depression.	**CLO 2**
Unit-3/15hr	**Introduction and Pathophysiology of Brain Stroke** Definition of Brain Stroke, types of stroke, Impact of stroke globally and in India, risk factors, diagnosis, pathophysiology of ischemic brain injury- Glutamate Excitotoxicity, receptors involved in excitotoxicity, EAA antagonists. Acidosis and neuronal death: Role of novel ion channels. Oxidative stress in ischemic brain injury, Free radicals measurement and potential of free radical scavengers.	**CLO 3**
Unit-4/15hr	**Neurovascular changes and Therapeutics of Brain Stroke:** Role of Blood Brain Barrier, Neuronal swelling, cytotoxic edema, Immune pathology and neuro inflammation, signaling pathways. Neuronal death cascades: Apoptosis, necrosis and autophagy, signalling cascades and proteins involved in neuronal death cascades. Advances in drug development of cerebral stroke: Thrombolytic agents, Antithrombotic agents, Antiplatelet agents, Anti-oxidants, Calpain inhibitors, PARP inhibitors, Apoptosis inhibitors, Preventive measures and Surgical treatment	**CLO 4**

Suggested Readings

1. B. G Katzung, (2021) Basic and Clinical Pharmacology. 15th edition, McGraw-Hill
2. Robbins & Cortan (2020) Pathologic Basis of Disease, 10th Ed. (Robbins Pathology), Elsevier
3. Chrousos GP. (1992) Regulation and dysregulation of the hypothalamic-pituitary-adrenal axis. The corticotropin-releasing hormone perspective. Endocrinol Metab Clin North Am;21:833-858.
4. Dipiro Pharmacology (2020). A pathophysiological approach. 11thedition, McGraw-Hill Education
5. George Somjen. (1988) Mechanisms of Cerebral Hypoxia and Stroke. Springer Publications.
6. Kormos V, Gaszner B. (2013) Role of neuropeptides in anxiety, stress, and depression: from animals to humans. Neuropeptides. 47:401-19.
7. Laurence Brunton, Bjorn Knollman and RandaHilal-Dandan (2017).The Pharmacological Basis of Therapeutics, Goodman and Gillman's 13th edition by McGraw-Hill Education.
8. M.J. Zigmond, J.T. Coyle, L.P. Rowland (2014). (Eds.), Neurobiology of Brain Disorders, 1st edition. Imprint: Academic Press
9. Mark P. Mattson (2001). Pathogenesis of Neurodegenerative Disorders. Springer Publications.
10. Turkington, Carol. (2002). The Encyclopedia of the Brain and Brain Disorders. Second Edition. Infobase Publishing
11. Yang V. Li John H. Zhang. (2012) Metal Ion in Stroke. Springer Publications.

The following are some of the modes of classroom transaction

1) Lecture
2) Demonstration
3) Lecture cum demonstration
4) Video

Course Title: Recent advancement and new drug targets in Endocrine disorder

Course code: PPL.706

Total Hours: 60hrs

Course Learning Outcomes

CLO 1: Understand the complex pathophysiology of disorder such as diabetes, fatty liver disease and its complications
CLO 2: Understand the pathophysiology of fatty liver disease.
CLO 3: Understand the concept of epigenetic modification and role in metabolic disorder
CLO 4: It would ignite the mind of budding research ideas of research scholar in term of new targets identification

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/15hr	General introduction of diabetes mellitus and its types. Pathophysiology of diabetes mellitus and its related disorders such as macrovesicular and microvesicular diseases. Compensatory mechanism of pancreatic beta cell in regulation of glucose homeostasis.	**CLO 1**
Unit-2/15hr	General introduction of non-alcoholic fatty liver diseases (NAFLD) and non- alcoholic steatohepatitis (NASH). Pathophysiology of NASH and crosstalk of Multiple Pathways in hepatic Injury and NASH.	**CLO 2**
Unit-3/15hr	Role of metabolic sensors, transcription factor (FOXO1, PPARG etc.) in pathophysiology of metabolic disorders such as diabetes and fatty liver diseases. Introduction to epigenetic and its modification such as DNA methylation & histone modification. Role of Epigenetic in development and progression of pathophysiology of metabolic disorders.	**CLO 3**
Unit-4/15hr	Novel Therapeutic Targets and Experimental Drugs for the Treatment of diabetes and NAFLD. Novel compounds or herbal drugs regulating epigenetic modification.	**CLO 4**

Suggested Readings

1. Laurence Brunton, Bjorn Knollman and Randa Hilal-Dandan (2017). The Pharmacological Basis of Therapeutics, Goodman and Gillman's. 13th edition by, McGraw-Hill Education,
2. Trygve Tollefsbol (2018). Epigenetics in Human Disease (ISSN Book 6) 2nd Edition, Kindle Edition
3. Arthur J. McCullough (2013) Non- Alcoholic Fatty Liver Disease: A Practical Guide Editor (s) Geoffrey C. Farrell. Arthur J. McCullough, Christopher P. Day MA (Cantab).
4. B. G Katzung, (2018). Basic and Clinical Pharmacology by 14th edition, McGraw-Hill,
5. Graham Smith. (2002). Oxford textbook of Clinical Pharmacology, 3rd edition,

6. Oxford University Press,

7. Trevor M. Speight and Nicholas H.G (2012) A very Drug Treatment. Holford, 4th edition, Wiley India Pvt Ltd.
8. DiPiro, Robert L. Talbert, Gary C. Yee, Gary R. Matzke, Barbara G (2017). Dipiro Pharmacology: A pathophysiological approach. 10th edition, McGraw-Hill Education,
9. Robbins & Cortan (2014) Pathologic Basis of Disease, 9th Ed. (Robbins Pathology), Elsevier.
10. S. K. Srivastava (2017). A Complete Textbook of Medical Pharmacology 2nd edition by published by APC Avichal Publishing Company.

The following are some of the modes of classroom transaction
1) Lecture
2) Demonstration
3) Lecture cum demonstration
4) Video

Course Title: Movement and Cognitive Disorders: From Basic to Recent advances

Course code: PPL707

Total Hours: 60hrs

Course Learning Outcomes

CLO 1: Understand the molecular pathophysiology of Movement and cognitive disorders.
CLO 2: Understand different types, prevalence and etiology, risk factors, diagnosis of movement and cognitive disorders.
CLO 3: Understanding of role of neurotransmitters, excitotoxicity and mitochondrial dysfunction in movement and cognitive disorders
CLO 4: Understanding of signaling pathways in movement and cognitive disorders
CLO 5: Recent advancement in movement and cognitive disorders

Unit/hr	Course Content	Course Learning Outcomes
Unit-1/5hr	Introduction to Movement and Cognitive disorders Definition, Classification, types, prevalence and etiology, Risk factors, Diagnosis - major symptoms, clinical manifestations, secondary complications.	**CLO 1**
Unit-2/15hr	Pathophysiology of Movement and Cognitive disorder Pathophysiology of Parkinson's disease, Tardive dyskinesia, Huntington's disease and epilepsy. Basal Ganglia, direct and indirect pathways. Pathophysiology of amyloidogenesis and its related disorders. The physiology of amyloid beta clearance and storage. Introduction, synthesis, clearance and storage, phosphorylation and dephosphorylation of tau protein.	**CLO 2**
Unit-3/15hr	Neurotransmitters, Oxidative stress, excitotoxicity and mitochondrial dysfunction in movement and cognitive disorders Role of neurotransmitters, oxidative stress, excitotoxicity, mitochondrial dysfunction, neuroinflammatory markers. Role nitric oxide in movement and cognitive disorders. Role of mitochondrial bioenergetics in the pathophysiology of amyloidogenesis and tauopathy.	**CLO 3**
Unit-4/15hr	**Down regulating pathways in movement and cognitive disorders** Role of MAPK signalling, ERK, JNK pathway and the p38 pathways, Apoptosis, necrosis and autophagy, signalling cascades and proteins involved.	**CLO 4**
Unit-4/10hr	**Recent advancement in movement and cognitive disorders** Advances in drug development, drugs in clinical trials, Non-Pharmacological treatment for movement and cognitive disorders. Animal models of movement and cognitive disorders.	**CLO 5**

Suggested Reading:

1. Mark P. Mattson (2010). Pathogenesis of Neurodegenerative Disorders. 1st edition, Springer Publications.
2. Turkington, Carol. (2009). The Encyclopedia of the Brain and Brain Disorders. 3rd Edition. Infobase Publishing
3. Laurence Brunton, Bjorn Knollman and RandaHilal-Dandan (2017). The

Pharmacological Basis of Therapeutics, Goodman and Gillman's 13th edition, McGraw-Hill Education.

4. B. G Katzung, (2021) Basic and Clinical Pharmacology. 15th edition, McGraw-Hill
5. Dipiro Pharmacology (2020). A pathophysiological approach. 11thedition, McGraw-Hill Education
6. Robbins & Cortan (2020) Pathologic Basis of Disease, 10th Ed. (Robbins Pathology), Elsevier.
7. S. K. Srivastava (2017). A Complete Textbook of Medical Pharmacology 2nd edition by published by APC Avichal Publishing Company.

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