SHIVAJI UNIVERSITY, KOLHAPUR
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शिवाजी विद्यापीठ, कोल्हापूर, ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
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Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

Ref.: SU/BOS/ *IDS* / 607 **Date: 06 - 10- 2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

Subject : Regarding revised syllabi of **B. Voc. Part I (Sem. I & II)** degree programme under the Faculty of Inter- Disciplinary Studies as per NEP-2020 (2.0).

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of **B. Voc. Part I (Sem. I & II)** for follower's degree programme under the Faculty of Inter- Disciplinary Studies as per National Education Policy, 2020 (NEP 2.0).

Course
B. Voc. Advanced Diploma In Medical Laboratory Technology Part -1
B. Voc. Building Technology and Interior Design Part -1
B. Voc. Printing & Publishing Part -1
B. Voc. Nutrition and Dietetics Part – I

This syllabus, nature of question and equivalence shall be implemented from the academic year **2025-2026** onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020 (Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours Faithfully

(Dr. S. M. Kubal)
Dy Registrar

Encl. : As above.

Copy to: For Information and necessary action.

1	The Dean, Faculty of IDS	7	Affiliation T. 1 & T. 2 Section
2	Director, Board of Examination and Evaluation	8	Appointment A & B Section
3	The Chairman, Respective Board of Studies	9	P.G.Seminar Section
4	All On Exam Section	10	I.T. Cell
5	Eligibility Section	11	Internal Quality Assurance Cell (IQAC)
6	P. G. Admission Section		

Shivaji University Kolhapur

Established: 1962

Accredited By NAAC with 'A++' Grade with

CGPA 3.52

Revised Syllabus For

Bachelor of Vocation [B. Voc.] (NEP-2.0)

Part-I

Advanced Diploma In Medical Laboratory Technology

UNDER

Faculty of Interdisciplinary Studies Structure, Scheme and Revised Syllabus

(To be implemented from academic year 2025-26 onwards)

Shivaji University, Kolhapur

NEP-2020 (2.0): Credit Frame work for UG B. Voc. I Program Under Faculty of Interdisciplinary Studies

B. Voc. Part I Advanced Diploma in Medical Laboratory Technology

Level	Semester	COURSES			OE	VSC/ SEC	AEC/VEC/IKS	OJT/FP/ CEP/ CC/ RP	Total Credit
		Course –I	**Course -II**	**Course -III**			IKS		
4.5	I	DSC-I (2) DSC-II (2) DSC Pract. I (2)	DSC-I (2) DSC-II (2) DSC Pract. I (2)	DSC-I (2) DSC-II (2) DSC Pract.I (2)	OE -I (T) (2)		IKS-I (2) Introduction to IKS		
	Credits	**4+2=6**	**4+2=6**	**4+2=6**	**2**		**2**		**22**
	II	DSC-III (2) DSC-IV (2) DSC Pract. II (2)	DSC – III (2) DSC-IV (2) DSC Pract.II(2)	DSC-III (2) DSC-IV (2) DSC Pract.I(2)	OE-II (T) (2)		VEC-I (2) (Democracy, Election and constitution)		
	Credits	**4+2=6**	**4+2=6**	**4+2=6**	**2**		**2**		**22**
1st Year Cum. Credits		**8(T)+4(P)= 12**	**8(T)+4(P)= 12**	**8(T)+4(P)= 12**	**2+2 =4**		**2 + 2= 4**		**44**
Exit Option: Award of FY Diploma Certificate with 44 Credits									

Semester I B. Voc. Advanced Diploma in Medical Laboratory Technology

Sem.	Course	Code	Paper No.	Title of Paper
I	I	DSC- I	B. Voc. Paper- I	Basics of Medical laboratory Technology
		DSC- II	B. Voc. Paper- II	Hematology
		DSC- P- I	B. Voc. Practical –I	Based upon DSC-I and DSC- II
	II	DSC- I	B. Voc. Paper- I	Blood banking and services
		DSC- II	B. Voc. Paper- II	Histotechnology
		DSC- P- I	B. Voc. Practical –II	Based upon DSC-I and DSC -II
	III	DSC- I	B. Voc. Paper- I	Human anatomy and Physiology
		DSC- II	B. Voc. Paper- II	Parasitology
		DSC- P- I	B. Voc. Practical –III	Based upon DSC – I and DSC - II
	OE -I	Open Elective	Theory (2)	Community Medicine & Statistics
	IKS	Indian Knowledge System	Theory (2)	IKS (Generic)

Semester II B. Voc. Advanced Diploma in Medical Laboratory Technology

Sem.	Course	Code	Paper No.	Title of Paper
II	I	DSC- I	B. Voc. Paper- I	Laboratory Principles and instrumentation
		DSC- II	B. Voc. Paper- II	Basics of Biochemistry
		DSC- P- I	B. Voc. Practical – I	Based upon DSC -I and DSC-II
	II	DSC- I	B. Voc. Paper- I	Microbiology
		DSC- II	B. Voc. Paper- II	Bacteriology
		DSC- P- I	B. Voc. Practical – II	Based upon DSC – I and DSC - II
	III	DSC- I	B. Voc. Paper- I	Cytology
		DSC- II	B. Voc. Paper-II	Enzymology
		DSC- P- I	B. Voc. Practical- III	Based upon DSC – I and DSC - II
	OE -II	Open Elective - II	Theory (2)	Computer Application in Healthcare
	VEC	Value Education Course	Theory (2)	Democracy, Election and Good Governance

SHIVAJI UNIVERSITY, KOLHAPUR

B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - I) DSC– I B. Voc. Paper I

Basics of Medical Laboratory Technology

Theory: 30 Hours **(Credits: 02)**

Unit I : Introduction to Clinical laboratory and management (9 Hrs)

1. Introduction of the clinical laboratory, components & department of clinical Laboratory.
2. Laboratory quality control. Collection and handling of specimens. Laboratory safety & biohazards: Safety manuals of a clinical laboratory, Management of physical, chemical & biological hazards of clinical laboratory.
3. Maintenance of cleanliness of the laboratory: maintenance of cleanliness, Personal Health and hygiene, cleaning of laboratory glassware, cleaning pipette.
4. Proper clinical waste disposal. Components, uses and management of First Aid Box in the laboratory

Unit II : Training of technician, Sterilization & disinfection (6Hrs)

1. Scope of medical laboratory technology, Role of technician in clinical laboratory, basic ethics of laboratory technician. Training of clinical laboratory technicians.

2. Sterilization & disinfection: Introduction of sterilization & disinfection. Differences between sterilization & disinfection, different methods and procedure of sterilization. Different disinfectants & their procedure of disinfection.

3. Procedure for sterilization of glassware's, infected materials, plastic materials, culture media & solutions.

4. Process of sterilization in autoclave & hot air oven.

5. Concept of septic & aseptic conditions.

Unit III : Common Laboratory Equipment's 7Hrs.

1. Incubator, Hot Air Oven, Water Bath, Centrifuge, Autoclave, Spectrophotometer, Balance.
2. Microscope – Fundamentals of Microscopy, Resolution & Magnification Light Microscopy,
3. Glassware – Description of Glassware, its use, handling and care,
4. Colorimeter,

5. Blood cell counter

Unit IV: Manual Vs Automation in Clinical Laboratory (8Hrs.)

1. Types of analyzers - Semi-auto analyzer, Batch analyzer, Random Access autoanalyzers.
2. Steps in the automated systems
3. Responsibilities of a technician in the maintenance of the analyzers

Reference Books:

- .Maithi, Text book of medical laboratory Technology.
- V.H Talib, A hand book of Medical laboratory Technology, CBS Publishers & distributors, New Delhi.
- Fichbach, 2005 Manual of Lab and Diagnostic Tests, Lippincott Willams Wilkins, New York.
- Gradwohls, 2000 Clinical Laboratory Methods and Diagnosis (Ed) Ales C. Sonn Enwirth and Leonard Jarret, M.D.B.O, New York.
- J. Ochei and Kolhatka, 2002 Medical Laboratory Science Theory And Practice, Tata McGraw Hill, New Delhi.
- Kanai L. Mukharjee, 2007 Medical Laboratory Technology Vol. 1 Tata McGraw Hill Delhi.
- Girdharilal, siddappaa, G.S. and Tanden, G.I. (1998), Preservation of fruits and vegetables, ICAR, New Delhi.
- Raw I. S. (2013), Food Quality Evaluation (1st Ed.)

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - I) DSC– II B. Voc. Paper II

Hematology

Theory: 30 Hours **(Credits: 02)**

Unit I : Composition of Blood **8Hrs.**

1. Introduction - Composition of blood, its formation and functions.
2. Collection of blood - Different routes, difference between capillary and venous sample.
3. Anticoagulants - Different types, method of preparation and uses.

Unit II : Erythrocytes **8Hrs.**

1. Haemoglobin - Normal and abnormal values and Physiological variations; Estimation by (a) Colorimetric Method, (b) Sahli's Method, and (c) Specific Gravity Method. Clinical importance.
2. Red Blood Cells : Total Count - Normal, abnormal values, and Physiological variations, Haemocytometer - method and calculation; Anemia – Classification, Sickle cell anemia – Sickling test, Haematocrit – Normal and abnormal values,
3. Red Cell indices – MCV,MCH & MCHC & its Importance

Unit III : leucocytes **6Hrs.**

1. White Blood Cells: Differential Count :- Normal, abnormal values and physiological variation; Preparation of peripheral blood smear, Staining by different methods, Methods of Examinations and reporting;
2. Total White Blood Cell Count : Normal and abnormal values
3. Haemocytometer: method and calculation.

Unit IV: Reticulocytes and Coagulation Mechanism **8Hrs**

(a) Reticulocytes : Methods, Normal values and significance.

(b) Haemostasis and Coagulation Mechanism- Coagulation Factors, Coagulation Test –

(a) Bleeding time, (b) Clotting time, (c) Whole Blood Coagulation time, (d)Tourniquet test,(e) Clot retraction test (f) Prothrombin time (PT).

Reference books

- Roitt's Essential Immunology by Ivan Roitt & Peter J Delves, Oxford, Backwill science publication London. 10e.
- Elgert: Immunology understanding the immune system, John Willy & Sons, Inc. Publication, New York 1996.
- Abbas et al. Cellular & Molecular Immunology (3rd Ed.) W.B. Saunders Company, 2000.
- Kuby Immunology 4 Ed.

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - I) DSC– Practical B. Voc. Paper III

Basics of Medical Laboratory Technology and Hematology

Theory: 30 Hours **(Credits: 02)**

List of Practical's:

Group – I

Practical's Based Basics of Medical Laboratory

1. Study the different types of clinical samples and their collections.
2. Study of transport of samples, screening of samples, Reporting and Dispatch of Reports.
3. Study the basic laboratory equipment's
4. Study the method of cleaning laboratory glasswares.
5. Study of washing hands using seven step rules.
6. Prepare the First Aid Box.
7. Sterilize the glasswares using hot air oven.
8. Sterilization the materials using autoclave.
9. Prepare the 70% ethanol.

Group – II

Practical's Based Basics of hematology

1. Study the method of blood sample collection
2. Estimation of hemoglobin percentage of blood.
3. Determination of total RBC count
4. Determination of total WBC Count
5. Differential total leucocytes count
6. Demonstration of PCV of blood
7. Determination of bleeding time of blood
8. Determination of clotting time of blood.

Reference Books:

- K Sri Nageswari and A. Kthari, Practical Manual of Haematology, Jaypee.

- Dr. B. K. Prasad, Practical Physiology and Hematology.
- R. P. Jayaswal, Hematology Manual
- Dr. Tejinder Singh, Text and Practical Hematology.

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - II) DSC–DSC-I B. Voc. Paper I

Blood banking and services

Theory: 30 Hours **(Credits: 02)**

Unit I: Blood Collection and Blood Grouping **10 Hrs**

1. **Blood Collection** (i) Collection of Blood (ii) Storage of Blood (iii) Anticoagulation use for collection of Blood (iv) Screening of doner
2. **ABO & Rh Blood Group System –** (i) ABO Grouping by Slide Method & Tube Method (ii) Antigen and type of Antibodies (iii) Rh system with slide method (iv) Type of Antibodies (v) One/Two stage Albumin Technique for Rh Factor .

Unit II: Blood Donation **8Hrs**

1. **Blood Donation** Introduction -Blood donor requirements - Criteria for selection & rejection-Medical history & personal details -Self-exclusion-Health checks before donating blood-Screening for TTI.
2. **Testing Donor Blood:** Screening donor's blood for infectious agents - HIV, HCV, HBV, Trepanoma palladium, Plasmodium, HTLV-Bacterially contaminated Blood.

Unit III: Storage and Transport of Blood **6Hrs**

1. **Storage, preservation & Transport of blood:** Whole Blood - Platelets - Leucocytes - Plasma - Fresh Frozen Plasma
2. **Anticoagulant & Preservatives**

Unit IV: Blood Bank Refrigerator and Compatibility Testing **6Hrs**

1. Changes in blood after storage
2. Lay out of a blood bank refrigerator
3. Compatibility Testing: Purpose - Single tube compatibility techniques using AHG reagent.- Emergency compatibility testing

Reference Book:

- Blood Bank Operations, G. Guru 1st Edn.1991, NCERT, New Delhi.
- Blood Banking Training Manual, Indian Society for Blood Banking, 1st Edn.1995,Dr. Dilip Wani, Janakalyan Bldg. , Pune.

- Modern Blood Banking & Transfusion Practices by Denise & M. Harmening
- Text Book of Blood Banking & Transfusion Medicine by Sally V. Rudmann.
- Mollison’s Blood Transfusion in Clinical Medicine by Klein, Mollison’s.
- Essentials of Blood brouping & Clinical Application by K. P. Ranganathan. \ Blood Bank Technology by Williams & Williams.
- Blood Transfusion- A guide to formation & Operation of transfusion devices by C. L. Bowley.

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - II) DSC–DSC-II B. Voc. Paper II

Histotechnology

Theory: 30 Hours **(Credits: 02)**

Unit I: Basics of Histotechnology **6Hrs**

1. Cells, Tissues & their function.
2. Methods of examination of tissue and cells

Unit II: Fixation and Processing of tissue **8Hrs**

1. Fixation of tissue: Simple fixatives, Cytological fixatives, Histochemical fixatives
2. Tissue processing: Collection of specimen, Labeling and fixation, Dehydration, Clearing Impregnation, Embedding.

Unit III: Sectioning and Staining **8Hrs**

1. Section Cutting: Microtomes and microtomes knives, Techniques of section cutting, mounting of sections, frozen section.
2. Staining: Dyes and their properties, Basic theory of staining, Staining technique with haematoxyline and eosin, Common special stains.

Unit IV : Autopsy **8Hrs**

Autopsy Techniques (i) Processing of Tissues (ii) Preservation of Orange

Reference Book:

- Hand Book of Histopathological and Histochemical Technique C.F.A. Culling
- Introduction of Medical Labotaroy Technology F.J. Baker and R.E. Silverton.
- Theory and Practice of Histological Technique. John D. Baneroft and Alan Steven,
- An Introduction to Histotechnology. Geoffrey G. Brown.,
- A Manual for Histologic Technician. Aun Preece, J
- Hand book of MLT by V.H. Talib.
- Hand book of MLT by R. Sood.
- Hand book of MLT by Mukherjee.
- WHO technical manual of Laboratory technology.
- WHO technical manual of Blood banking transfusion medicine.

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - II) DSC– Practical B. Voc. Paper III

Blood banking and services Histotechnology

Theory: 30 Hours **(Credits: 02)**

List of Practical's:

Group – I

Practicals based on blood banking and services

1. Screening of donors.
2. Preparation of anticoagulant fluids
3. To detect the blood group of given and own blood sample.
4. To detect the RH factor of blood
5. Cross matching of blood samples.

Group – II

Practicals based on Histotechnology

1. Embedding and preparation of blocks
2. Study the type of microtome
3. Section cutting and use and care of microtone
4. H & E staining
5. PAS staining
6. AFB staining [TB and leprosy}
7. Frozen section and care of ctyosist
8. Preparation of fixative.

Reference Books:

- B. Sheety and S. Poonja, Histology Practical Manual
- N. Vasudeva and S. Mishra, Indebirs Sings Textbook of Human Histology with colour atlas and Practical Guide
- S. R. Prasad, Practical Histology for Medical Students
- Hina Sharma, Practical Manual of Histology

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - III) DSC– I B. Voc. Paper I

Human Anatomy and Physiology

Theory: 30 Hours **(Credits: 02)**

Unite I: Introduction to anatomy and Cardio Vascular System 8Hrs

1. **Introduction to anatomy:** Scope of Anatomy and Physiology – Definitions and Terms in Anatomy and Physiology structure and function of human cell – Elementary tissues of human body.
2. **Cardio Vascular System:** Brief account on composition blood – function of blood elements – blood group and Rh typing, Coagulation of blood. Structure and functions of various parts of the heart & its function & Blood pressure.

Unit II: Respiratory System and Digestive System 6Hrs

1. **Respiratory System:** Structure & function of lungs, Physiology of breathing, Lung volume & capacity.
2. **Digestive System:** Name and various parts of digestive system Liver, Spleen, gall bladder, Pancreas, Buccal Cavity, tongue, tonsil, Pharynx, Oesophagus, Stomach, intestine etc. – Physiology of digestion and absorption.

Unit III: Urinary System and Reproductive System 8Hrs

1. **Urinary System:** Structure and function of kidneys, its role in urine formation, ureter, urinary bladder, Mechanism of Micturition.
2. **Reproductive System:** Anatomy & Physiology of Male & Female reproductive system, menstrual cycle, Contraceptives.

Unit IV: Nervous System and Endocrine System 8Hrs

1. **Nervous System:** Elementary knowledge of structure – functions of nervous system – Brain, Spinal Cord & Nerves.
2. **Endocrine System:** Endocrine glands their hormones and functions – Thyroid, Parathyroid, suprarenal, Pituitary and Thymus.

Reference Book:

- Solon on E.A. (2008) Introduction to Human Anatomy and Physiology 3rd Ed. Saunders: St Louis.
- Chaursia, B.D. & Garg, K., (2012) Human Anatomy Regional and Applied CBS Publications: New Delhi
- T.S. Ranganathan – A text book of Human Anatomy
- Fattana, Human anatomy (Description and applied) Saunder's & C. P. Prism Publishers, Bangalore – 1991
- W. F. Ganong - Review of Medical Physiology
- Human Physiology (Vol. I, IV) C.C. Chatterjee 1992. 11th Edn. Medical Allied

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - III) DSC– II B. Voc. Paper II

Parasitology

Theory: 30 Hours **(Credits: 02**

Unit I: Introduction to Parasitology **06Hrs**

1. Introduction and types of parasites
2. Host and their types
3. Host-parasite interaction

Unit II: **8Hrs**

Morphology, Life-cycle, Pathogenicity and Laboratory diagnosis of protozoa such as: *E. histolytica and Entamoeba coli* and *Giardia, Trichomonas, Toxoplasma, Plasmodia and Leishman*

Unit III **8Hrs**

Morphology, Life-cycle, Pathogenicity and Laboratory diagnosis of following helminthes and nematodes: Hook worm, Round worm, Whip worm, Thread worm, Pin worm. (b) Tapeworm and *Echinococcus, Wucheria bancrofti and B. malayi.*

Unit IV: Trematodes and Sporozoa **8Hrs**

1. **Morphology, Life-cycle, Pathogenicity and Laboratory diagnosis of Trematodes of Flukes** :Fasciola hepatica, Fasciola gigantica, Gestrodiscoides hominis
2. **Morphology, Life-cycle, Pathogenicity and Laboratory diagnosis of Sporoza:** Malaria Parasite and *Balatidium Coli.*

Reference Books

- Parasitology - K. D. Chatterji ,11th Edn. 1976 Chatterji Medical Publisher, Kolcata
- Medical Parasitology- V. Baveja and C.P. Baveja, 4th Edn. 2019, Arya Publishing Company.
- Medical Parasitology- Arora D. R., 5th Edn. 2020, CBS publisher and distributor Pvt. Ltd.

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

Course - III) DSC– Practical B. Voc. Paper III

Human Anatomy and Physiology and Parasitology (Practical)

Theory: 30 Hours **(Credits: 02**

List of Practical's:

Group - I

Practicals based on human anatomy and physiology

1. Demonstration of parts of body and land marks on the surface.
2. The human skeletal system
3. Identification of models like those of Brain, Heart, embryology, Kidney.
4. The microscope, its usage, cleaning & maintenance
5. Identification of blood cells under Microscope. RBC, various types of WBC, pallets, Reticulocytes
6. Preparation of anti- coagulants
7. Demonstration of blood pressure recording and pulse
8. Ruling area of Neubaur chamber

Group – II

Practical's based on parasitology

1. Demonstration of gross specimen of- Hookworm, Roundworm, Whip worm, Thread worm, Pin worm and Tape worm,
2. Demonstration of following parasites / ova / cyst under microscope *G. lamblia*, (b) *T. vaganalis*,
3. Demonstration of following parasites / ova / cyst under microscope: Malerial parasites and *Leishmania*

4. Demonstration of following parasites / ova / cyst under microscope: Roundworm and) Pin worm
5. Demonstration of following parasites / ova / cyst under microscope: Whipworm, Threadworm and Tapeworm
6. Study the life cycle and Pathogenicity of malarial parasite.
7. Study the life cycle and Pathogenicity of , *Wucheria bancrofti*

Reference Books:

- S.R. Kale and R. R. Kale, Practical human anatomy and physiology
- BD Chaurasis Human Anatomy: Regional and applied Dissection and clinical.
- Everest publications- A practical Book on Human Anatomy and Physiology
- V. D. Sharma and S. K. Panday, Human Anatomy and Physiology, Practical Note book.
- Elizabeth A. Zeibig, Clinical Parasitology
- D. R. Arora and B. B. Arora, Medical Parasitology
- Rajesh Karyakarate and Ajit Damale, Medical Parasitology
- K. D. Chatterjee, Parasitlogy (Protozoology and Helmintology)

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

OPEN ELECTIVE – I (Theory)

Community Medicine & Statistics

Theory: 30 Hours **(Credits: 02**

Unit:1 Community Medicine **(15 Hours)**

1. **Identification and Public Health Importance of arthropods (Entomology):** Mosquitoes, Lice, Fleas, Flies, Rats & Rodents.
2. **Water Sources:** Types, Purification
3. Bio-Medical Waste Management
4. Sanitation in Public Health
5. Food and Nutrition: Collection of different food samples :Cereals, Pulses, Vegetables, Roots and tubers, Fats and oils, Animal foods including milk
6. Food-borne diseases of Public Health importance, Assessment of Nutritional status.

Unit:2 Statistics **(15 Hours)**

1. Tables: Simple Tables,

2. Frequency Distribution diagrams: Bar Diagrams, Histogram, Line Diagram Pie Diagram

3. Statistical Averages: Mean, Median, Mode

4. Measures of dispersion: Normal Curve, Range, Standard Deviation Standard Error.

5. Tests of significance: 't' Test.

Reference Books:

1. Public Health and Preventive Medicine - "The RED BOOK", By AFMC, Pune in Collaboration with WHO India Office,New Delhi.
2. Park J E & K. Park, Text Book of P & S.M., M/S Banarsidas Bhanot, Jabalpur
3. Textbook of Community Medicine: Preventive and Social Medicine, by Sunderlal
4. Maxcy Rosenau John M. Last, Public Health and Preventive Medicine, McGraw-Hill Medical; 15 edition
5. Oxford Textbook of Public Health by from Oxford University Press, USA
6. The Theory and Practice of Public Health by William Hobson from Oxford Med. Publication
7. Mahajan B K and M.C. Gupta, Text Book of P & S.M., Jaypee Publications

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B. Voc. Part I Sem. I: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

IKS – I (Theory)

Theory: 30 Hours **(Credits: 02**

SYLLABUS IS SAME FOR ALL B VOC COURSES

SHIVAJI UNIVERSITY, KOLHAPUR

B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - I) DSC– I B. Voc. Paper I

Laboratory Principles and Instrumentation

Theory: 30 Hours **(Credits: 02**

Unit: 1 Laboratory Glass wears and Measurement (8 hours)

1. Laboratory glass wares -General laboratory wares -glass & plastic, glasses – composition ,properties & verities, grades of glass-wares, testing of new glass-wares & storage of glass wares, preparation of cleaning solutions, cleaning of new and used glass-wares in Biochemistry , calibration of volumetric glass-wares.

2. Preparation of pure water-Preparations of distilled water, double distilled water and deionized water

3. Measurements - Units of measurements, SI units, Methods of measuring liquids and weighing chemicals.

Unit: 2 Laboratory Instruments and Organization (7 hours)

1. Laboratory instruments - Working -principle, use and maintenance of the following instruments / apparatus - Heater, centrifuge, water-bath, refrigerator, vortex mixer, magnetic stirrer, Homogenizer, incubator, densitometer, desiccators, Balances -analytical, single pan balance -electrical and electronic balances.

2. Laboratory organization - General principles of organization of a clinical laboratory, ventilation, lighting, work benches, water and waste water. Chemicals / reagents and its storage

Unit: 3 Laboratory Management and Safety (8 hours)

1. Laboratory Management - Familiarization of Request forms and report forms. Ordering and Utilization of supplies, Maintenance of Stock Registers- Consumables, Non-consumables Accreditation and Certification of Laboratories

2. Laboratory safety - Laboratory hazards in clinical laboratories, safety measures & first aid principle.

Unit: 4 Photometry **(7 hours)**

1. spectrum of light, monochromatic light, wavelength of light, color of solutions, absorption and transmission of light.

2. colorimeter- working principle, parts, calibration, selection of filters, colorimetric analysis, spectrophotometer, phototube, photomultiplier, flame photometer,

3. Briefly about -flurimetry, turbidimetry and nephalometry.

Reference Books:

- Principles of Instrumental Analysis *by Douglas A. Skoog, James J. Leary, F. James Holler, and Stanley R. Crouch.*
- linical Laboratory Instrumentation and Automation: Principles, Applications, and Selection *edited by Kory M. Ward, Craig A. Lehmann, and Alan M. Leiken.*
- Handbook of Medical Laboratory Instrumentation *(available in Kindle edition).*
- Handbook of Applied Instrumentation *by Bela G Liptak.*

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - I) DSC– II B. Voc. Paper II

Basics of Biochemistry

Theory: 30 Hours **(Credits: 02**

Unite I: Classification of Biomolecules **(7 hours)**

1. **Carbohydrates:** Classification**,** Glucose and Glycogen Metabolism
2. **Proteins:** Classification of proteins and functions
3. **Lipids:** Classification of lipids and functions

Unite II: Enzymes, Vitamins and Minerals **(8 hours)**

1. **Enzymes** Definition – Nomenclature – Classification – Factors affecting enzyme activity – Active site – Coenzyme – Enzyme Inhibition – Units of enzyme – Isoeznzymes – Enzyme pattern in diseases.
2. **Vitamins & Minerals:** Fat soluble vitamins(A,D,E,K) – Water soluble vitamins – B-complex vitamins- principal elements(Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chlorine and sulphur)- Trace elements – Calorific value of foods – Basal metabolic rate(BMR) – respiratory quotient(RQ) Specific dynamic action(SDA) – Balanced diet – Marasmus – Kwasoirkar

Unite III: Nucleic acid and Hormones **(7 hours)**

1. **Nucleic acid-** DNA, RNA Structure, Gene coding, Transciption & Translation Genetic Disorders
2. **Hormones :** Types and biochemical functions.

Unite IV: Electrolytes and Acid-Base Balance **(8 hours)**

1. **Minerals and Electrolytes:** Na, K, Cl ,Ca, Mg, I2, P, Fe and iron binding capacity
2. **Acid-Base Balance**: Regulation of blood pH, renal, respiratory and buffer system, importance of arterial blood gases.

Reference Books:

- Teitz, *Clinical Chemistry*. W.B. Saunders Company Harcourt (India) Private Limited New Delhi.
- Vasudevan D. & Sree Kumari S., *Text Book of Bio Chemistry for Medical Students*, Jaypee Brothers, New Delhi.
- Biochemistry, U. Satyanarayan, Books and Allied (P) Ltd. Kolkata-India
- Das Debajyothi, *Biochemistry,* Academic Publishers Calcutta.
- Text book of Medical Laboratory Technology, P.B. Godkar 2nd Edn. 2003 Bhalani
- Publication.
- Handbook of Biochemistry, M. A. Siddique 8th Edn.1993 Vijay Bhagat Scientific Book Co., Patna.

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - I) DSC– Practical B. Voc. Paper III

Laboratory Principles and Instrumentation and Basics of Biochemistry

Theory: 30 Hours **(Credits: 02**

List of Practical's:

Group – I

Practical's Based on Laboratory Principles and Instrumentation:

1. Familiarization of laboratory-wares used in Biochemistry laboratory
2. Demonstration of preparation of distilled water, double distilled water & de-ionized water.
3. Weighing of chemicals, Preparation of cleaning solutions in Biochemistry- and cleaning procedure.
4. Calibration of pipettes by gravimetric method, measurements of liquids.
5. Preparation of standard solutions- normal, molar & percentage, also saturated and half saturated solutions.
6. Preparation of standard solutions of oxalic acid, sodium hydroxide, hydrochloric acid, sulphuric -acid, Nitric -acid, potassium permanganate.
7. Preparation of buffer solution & checking of pH- phosphate buffer, carbonate buffer & citrate buffer.
8. Demonstration of osazones of glucose, fructose, lactose &maltose.

Group – II

Practical's Based on Laboratory Basics of Biochemistry

1. Demonstration of Kidney function test. Gastric function test & liver function test.
2. Demonstration of Enzyme Analysis -Acid and Alkaline phosphates, SGOT/SGPT. Lactic dehydrogenase, CPK.
3. Lipid profile.
4. Estimation of Blood/ serum-Glucose, G.T.T. Urea, creatinine, uric Acid, Cholesterol. BillRubin.protin & A/G Ratio, Glycosylated Hb.

5. Demostration of semi automated, Fully automated Biochemical Analyzers.
6. Demonstration/ Exposure to Radioimmuno assay laboratory.

Reference Books:

- Evangelin Jones, Manual of Practical Medical Biochemistry.
- Wolters Kluwer, South Asian Edition of Clinical Chemistry, Principles, Techniques and Correctionaltions.
- Willey, Basic Technique in Medical Biochemistry and Molecular Biology.
- Text book of Medical Laboratory Technology, P.B. Godkar 2nd Edn. 2003 Bhalani
- Publication.
- Handbook of Biochemistry, M. A. Siddique 8th Edn.1993 Vijay Bhagat Scientific Book Co., Patna.

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - II) DSC– I B. Voc. Paper I

Microbiology

Theory: 30 Hours **(Credits: 02**

Unit I: Introduction to Microbiology **(7 hours)**

1. Introduction to Microbiology, Morphological classification of Bacteria.
2. Culture media, types of media, special media.

Unit II: Growth and staining of bacteria **(8 hours)**

1. Nutrition and growth of bacteria
2. Sterilization and Disinfection (Physical and Chemical methods)
3. Staining of Bacteria: Gram stain, Negative Stain, Ziehl – Neelsen, Albert and Spore Stain.
4. Composition and preparation of staining Reagents and their composition.

Unit III: Morphology and Pathogenicity Bacteria **(7 Hours)**

a) Gram positive cocci-Staphylococci, Streptococci,

b) Gram negative cocci- Neisseria

c) Gram positive bacilli- Corynebacterium, Actinomy, Listeria, Bacillus, Clostridia, Mycobacterium tuberculosis and Mycobacterium leprae.

Unit IV: Pathogenic Gram negative bacilli and Antimicrobial susceptibility test **(8 Hours)**

1. Gram negative bacilli- Pseudomonas, Vibrio, Aerononas, Plesiomonas, Brucella, Haemophillus, ,Rickettsia, Mycoplasm Salmonella, Shigella,Vibrio
2. Antimicrobial susceptibility test.

Reference Books:

- Medical Microbiology by Patric R. Murray, Ken S. Rosenthel, Michael A. Pfaller.
- Text Book of Microbiology by Chakraborty.
- Microbiology An introduction by Tortora Funk, Case 12ed.
- Mackie & Mc Carthey - Medical Microbiology,
- Ananthansarayana, R., Jayaram Pumkar - Test Book of Microbiology.

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - II) DSC– I B. Voc. Paper I

Bacteriology

Theory: 30 Hours **(Credits: 02**

Unit: 1 Bacterial growth and cultivation **(8 hours)**

1. **Bacterial growth and nutrition –** Nutritional, Environmental requirements, growth curve
2. **Cultivation of Bacteria -** Equipments and devices used in the inoculation of bacteria, Inoculation methods- media in Petri dish- pour, spread, streak plate methods, Slopes, Butt, Broth.

Unit: 2 Bacterial Culture Media **(7 hours)**

1. Preparation of culture media- method, ingredients, pH adjustments, sterilization, quality control and storage of different types of media.

2. Basal Meia- Peptone water, Nutrient broth, Nutrient agar, Enriched - Blood agar, Chocolate agar, RCM, Enrichment - Alkaline- Peptone Water, Selenite F broth,

3. Selective media - MaC conkey agar, XLD, DCA, TCBSA, L.J.medium, Tellurite blood agar,

Unit: 3 Incubation and Growth characteristics of bacteria **(8 hours)**

1. Incubation methods – Incubators, Water bath, Carbon dioxide incubation, Anaerobic incubation- anaerobic jar, gas pack system.

2. Growth characteristics – Colony morphology of bacteria on solid media, liquid media.

Unit: 4 Biochemical Tests for identification **(7 hours)**

1. principle, preparation of media, reagents used, different methods, interpretation and quality control for the following identification tests.

2. Tests for the metabolism of Carbohydrates- OF test, simple sugar media, TSI/KIA,

Mannitol motility, citrate utilization, MR, VP tests,

3. Tests for the metabolism of proteins and Amino acids - Indole, PPA, Amino acid decarboxylase test.

4. Tests for enzymes. - Catalase, Urease, Nitrate reductase, Coagulase, and Oxidase, Commercial identification systems- API.

Reference Books:

- Ananthanarayan and Paniker's Textbook of Microbiology
- Clinical Microbiology Made Ridiculously Simple *by Mark T. Gladwin and Bill Trattler*
- Essentials of Microbiology for Postgraduates (Volume 2 Systematic Bacteriology) by Apurba S. Sastry

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

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(Course - II) Practical B. Voc. Paper II

Microbiology and Bacteriology (Practical)

Theory: 30 Hours **(Credits**

List of Practical's:

Group – I

Practicals based on Microbiology

1. Demonstration of various parts of light microscope, Should be thorough to the work with light microscope
2. Cleaning of new & used glass-wares for microbiological purposes.
3. Study the use of autoclave, hot air oven, water bath, incubator.
4. Demonstration of physical methods of sterilization – sterilization of glass wares, liquids, plastics and other laboratory wares, heat labile fluids.
5. study different type of filters & decontamination techniques.
6. Detection of motility – Hanging drop method, semi solid agar method
7. Preparation of smear, fixation, preparation of stains and reagents for the following staining techniques- Simple Staining –Methylene- blue, dilute carbol fuchsin, Gram's, AFB Staining – Ziehl – Neelsen, staining.
8. Negative staining for capsule.
9. Special staining for bacterial spore, volutin granules.

Group – II

Practicals based on Bacteriology

1. Identification of bacterial culture a. Colony characteristic. b. Morphological characteristic.
2. Types and preparation of media
3. Bacterial Staining: a) Gram staining technique b) Acid fast staining (Z-N).
4. Bacteria spore staining

5. Interpretation of biochemical reaction.
6. Antibiotic sensitivity test
7. Preparation of some stain's solution.
8. Pathogenicity of some bacteria.

Reference Books;

- Rajesh Bareja, Practical Medical Microbiology
- Mackie and McCartney, Practical Medical Microbiology
- Mukesh Kumar, Practical Manual for undergraduate Microbiology.
- J. Cappuccino and N. Sherman, Microbiology A laboratory Manual.

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - III) DSC– I B. Voc. Paper I

Cytology

Theory: 30 Hours **(Credits**

Unit: 1 Introduction to Cytology **(8 hours)**

1. Introduction – Organisation of cytology laboratory,

2. Comparison of applications of cytology

3. Brief knowledge of exfoliative and hormonal cytology

Unit: 2 Collection and staining of cytological sample **(7 hours)**

1. **Collection and processing –**Collection of specimens, preparation of smears, cytocentrifuge, fixation.

2. **Staining –** Brief knowledge of common stains used in cytology – Papanicoloau staining, Shorr staining, MGG staining.

Unit: 3 Quality control measure and Automation **(8 hours)**

1. Quality control measures in cytology

2. Automation in cytology

3. FNAC

Unit: 4 Cytogenetics **(7 hours)**

1. Introduction – Brief knowledge of metaphase preparation from blood and bone marrow specimens and karyotyping

2. Barr body – Demonstration using buccal and vaginal smears

3. Common cytogenetic abnormalities

Reference Books:

- Cytology: Diagnostic Principles and Clinical Correlates by Edmund S. Cibas and Barbara S. Ducatman.
- Diagnostic Cytopathology by Gabrijela Kocjan, Winifred Gray, et al..
- Atlas of Cytopathology: A Pattern Based Approach by Christopher J. Vandenbussche et al..
- Modern Techniques in Cytopathology edited by Marilyn M. Bui.
- Basic and Advanced Laboratory Techniques in Histopathology and Cytology by C. L. R. M. Annam et al..

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B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - III) DSC– II B. Voc. Paper II

Enzymology

Theory: 30 Hours **(Credits**

Unit: 1 Fundamentals of Enzymes **(8 hours)**

1. **Introduction to enzymes:** Definition, classification (IUBMB system), and nomenclature.
2. **Enzyme structure:** Apoenzymes, coenzymes, cofactors, and holoenzymes.
3. **Enzyme characteristics:** Specificity (lock-and-key and induced-fit models), active sites, and mechanism of action.
4. **Factors influencing enzyme activity:** Effect of temperature, pH, substrate concentration

Unit 2: Basic enzymology techniques **(7 Hours)**

1. **Enzyme assay methods:** Principles and procedures for measuring enzyme activity (endpoint and kinetic assays).
2. **Spectrophotometry:** Principles of photometry, Beer-Lambert's law, and its application in enzyme estimation.
3. **Instrumentation:** Working principles and application of colorimeters, spectrophotometers, and semi-automated analyzers for enzyme analysis

Unit 3: Clinical enzymology and biomarkers **(8 Hours)**

1. **Diagnostic significance:** Principles behind using enzyme levels to diagnose specific diseases based on organ damage.
2. **Organ-specific enzymes:** Cardiac markers: Creatine Kinase (CK, especially CK-MB) and Aspartate Aminotransferase (AST). Liver function tests: Alanine Transaminase (ALT/SGPT), Aspartate Transaminase (AST/SGOT), Alkaline Phosphatase (ALP), and Gamma-Glutamyl Transferase (GGT). Pancreatic enzymes: Amylase and Lipase.

Unit 4: Quality control and advanced applications **(7 Hours)**

1. **Quality control:** Importance of quality control (QC) in enzymology, including internal and external quality control measures.

2. **Sources of error:** Recognition and management of pre-analytical, analytical, and post-analytical errors in enzyme assays.
3. **Therapeutic applications:** Brief overview of enzymes used in therapy, such as thrombolytic enzymes.
4. **Point-of-care testing:** The role and principles of point-of-care testing for enzymatic markers, particularly for cardiac enzymes.

Reference Books:

- Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics *by Nader Rifai, et al.*.
- Medical Laboratory Technology: Methods and Interpretations *by Ramnik Sood.*
- Clinical Laboratory Methods and Diagnosis *by Gradwohl.*
- Diagnostic Enzymology (de Gruyter Textbook) *by J.J. Kazmierczak*
- Diagnostic Enzymology (de Gruyter Textbook) *by J.J. Kazmierczak*

SHIVAJI UNIVERSITY, KOLHAPUR

B. Voc. Part I Sem. II: Advanced Diploma in Medical Laboratory Technology

NEP 2020 (2.0)

(Course - III) DSC–Practical B. Voc. Paper III

Cytology and Enzymology

Theory: 30 Hours **(Credits**

List of Practical's:

Group – I

Practicals Based on Cytology

1. To study different epithelial cell types (superficial, intermediate, parabasal, basal)
2. To demonstrate epithelial cells, nuclear morphology, Barr body (sex chromatin).
3. To identify epithelial cells, inflammatory cells, and abnormal malignant cells
4. To detect shed epithelial cells, casts, and malignant cells.
5. To study method of sample collection from lumps/swelling.
6. To study bone marrow cell morphology
7. To detect inflammatory cells, malignant cells.
8. To identify premalignant and malignant changes in cervical epithelium.

Practicals Based on Enzymology

1. Analyzing the effects of **temperature**, **pH**, and **substrate concentration** on enzyme activity using an enzyme like amylase or acid phosphatase.
2. Analyzing the effects of **substrate concentration** on enzyme activity using an enzyme like amylase or acid phosphatase
3. Demonstrating the inhibitors (e.g., heavy metals, competitive inhibitors) affect enzyme reactions**.**
4. **SGPT (ALT)** for assessing liver function
5. **Alkaline Phosphatase (ALP)** for diagnosing bone and liver diseases
6. **Creatine Kinase (CK)** and its isoenzymes for detecting myocardial infarction (heart

attack).

7. **Estimation of Serum Alanine Aminotransferase (ALT)**
8. Enzyme Isolation and Purification

Reference Books:

- Textbook of Medical Laboratory Technology – Praful B. Godkar & Darshan P. Godkar
- Medical Laboratory Technology Methods and Interpretations – Ramnik Sood
- Practical Biochemistry for Medical and Dental Students – Harold Varley
- Textbook of Biochemistry for Medical Students – DM Vasudevan, S. Ramakrishnan
- Manual of Cytology – ***Ramadas Nayak & Vinayak Shenoy***
- Diagnostic Cytology – ***S. R. Arora***
- Clinical Cytology – ***P. Arul***

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NEP 2020 (2.0)

OPEN ELECTIVE – II (Theory)

Computer Application in HealthCare

Theory: 30 Hours **(Credits**

Unit:1 Basics of computer and Healthcare information system (15 Hours)

Introduction to computers: hardware, software, input/output devices, Operating systems (Windows/Linux basics), Introduction to MS Office (Word, Excel, PowerPoint) for lab reports and presentations, Role of computers in medical laboratories & hospitals, Hospital Information System (HIS): definition, components, benefits, Laboratory Information System (LIS): specimen tracking, reporting, data storage, Electronic Health Records (EHR) & Electronic Medical Records (EMR).

Unit:2 Data Management and Recent Trends (15 Hours)

Data entry, storage, retrieval, and security, Use of spreadsheets (Excel) for clinical/lab data analysis (formulas, charts, graphs), Basics of databases (MS Access/MySQL) in healthcare, Introduction to statistical tools in biomedicine, Artificial Intelligence (AI) and Machine Learning in healthcare, Medical imaging informatics (PACS systems), Cybersecurity & confidentiality of patient data., Legal and ethical aspects of computer use in healthcare.

Reference Book:

- Computer Applications in Medical Laboratory Technology – T. Jayalakshmi & A. Shakila
- Textbook of Medical Laboratory Technology – P.B. Godkar & D.P. Godkar
- Medical Laboratory Technology Methods and Interpretations – Ramnik Sood

SHIVAJI UNIVERSITY, KOLHAPUR

B. Voc. Part I Sem. II: Advanced Diploma In medical Laboratory Technology, NEP 2020 (2.0)

VEC

Democracy, Election and Constitution

(Credits: 02)

Compulsory to all B. Voc courses

SHIVAJI UNIVERSITY, KOLHAPUR

B. Voc. Part I (Advanced Diploma In medical Laboratory Technology) NEP 2020

(2.0) Semester – I & II : Theory

Nature of a Question Paper

Time: 1:00 Hrs. **Total Marks: 30**

Solve questions from the following.

Q. 1 Multiple choice Question **06 Marks**

i.

ii.

iii.

iv.

v.

vi.

Q. 2 Long answer Question (Any Two out of Three) **12 Marks**

i.

ii.

iii.

Q. 3 Short Answer Questions (Any Four out of Six) **12 Marks**

i.

ii.

iii.

iv.

v.

vi.

Internal Assessment **20 Marks**

Home Assignment
Class Assignment (Tutorial Type)
Quiz
Mid-Term Test

Nature of Practical Question Paper

Internal practical examination	**50 marks**
1. Group I	20 Marks
2. Group II	20 Marks
3. Submission of Certified Journal	10 Marks

Assessment:

The NEP 2020 emphasizes upon formative and continuous assessment rather than summative assessment. Therefore, the scheme of assessment should have components of these two types of assessments. Assessment has to have correlations with the learning outcomes that are to be achieved by a student after completion of the course

a) **Continuous Assessment:** Assignments, projects, presentations, seminars and quizzes
b) **Examinations:** Midterm, finals, or comprehensive exams.
c) **Research Projects/Dissertation/Thesis:** Evaluated through submission and viva-voce
d) **Grading System:** Standardized letter grades, percentages, or CGPA

Letter Grades and Grade Points:

The Semester Grade Point Average (SGPA) is computed from the grades as a measure of the student's performance in a given semester. The SGPA is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades in all courses taken after joining the programme of study. The HEIs may also mention marks obtained in each course and a weighted average of marks based on marks obtained in all the semesters taken together for the benefit of students.

Computation of SGPA and CGPA: UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

1. The SGPA is the ratio of the sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$\textbf{SGPA } (S_i) = \frac{\sum (C_{ix} G_i)}{\sum C_i}$$

Where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

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