



**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE**

**Faculty of Medical Sciences
DM - Critical Care Medicine
New Syllabus**



**Bharati Vidyapeeth Deemed to be University,
Pune**

Faculty of Medical Sciences

**Curriculum for DM Critical Care Medicine
As per Guidelines of
Medical Council of India**

COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR DM IN CRITICAL CARE MEDICINE

Preamble

Competency based postgraduate training programme for DM in Critical Care Medicine aims to produce a postgraduate student who after undergoing the required training should be able to deal effectively with the needs of the community and should be competent to handle all basic problems. The postgraduate students must gain ample of knowledge and experience in the diagnosis and treatment of patients with acute, serious, and life-threatening medical and surgical diseases. He / She should also acquire skills in supervision of paramedical staff and be able to work as a team member of the health care providers. He / She should be aware of his/her limitations and should be able to decide the point of referral.

The core components of clinical services of the specialty of Critical Care Medicine (CCM) or Intensive Care Medicine, as is known in many countries, revolves around life-support therapies under one roof to critically sick patients (medical, surgical and trauma etc.) who are admitted in the hospital area commonly named as General Adult Intensive Care Unit (ICU) (also known as General Adult Critical Care Unit -CCU) but specialists in Critical Care Medicine are responsible to take care of any of the critically sick patient admitted in any of the wards of the hospital.

Need Based Assessment of Course

DM in Critical Care Medicine (CCM) is a newly instituted postgraduate training programme in India and requires strategic planning for successful inception and growth. and the course is known as In the specialty of CCM, due to the convergence of knowledge and skills with the involvement of various primary specialties, there has been flexibility in the models of training, access, duration of training, regulation and certification systems across the globe. Trauma is an increasingly important problem affecting young individuals. Critical Care will be required to intensively monitor patients in trauma and to manage serious infections with multi-organ dysfunction.

At the end of training in CCM, the post graduate student should have acquired the following knowledge and skills:

1. General and specialist aspects of critical care, including management of the service,
2. Supervision of long-term collaborative management plans for larger number of patients,
3. Leadership for ICU team,
4. Teaching and supervision of junior colleagues,
5. Integration of information,
6. Effective functioning of critical care service within wider environments of case-mix,
7. Ability to plan professional development as a contribution to the holistic growth of specialty including patient care, teaching/training and research.

The trainee must gain experience in the diagnosis and treatment of patients with acute, serious, and life-threatening medical and surgical diseases. The curriculum of three-year training in Critical Care Medicine deals with the cognitive, psychomotor and affective domains covering following learning objectives:

SUBJECT SPECIFIC OBJECTIVES

The specific objectives of the course are:

1. Perform resuscitation and management of the acutely ill adult and pediatric patients,
2. Plan and organize therapeutic interventions/organ system support in single or multiple organ failure in conditions associated with trauma, burns, infections, metabolic derangements etc.
3. Plan end of life care,
4. Organize peri-operative care of surgical / trauma patients,
5. Plan and execute infection control procedures, system management and standard operative procedures in the Intensive (critical) Care Units,
6. Operate the monitoring gadgets and to detect and manage alterations in their functioning,
7. Communicate effectively and empathetically to patients and attendants, about the critical nature of illnesses, end of life care and breaking bad news in contingencies,

8. Lead and be a member of the team involved in critical care,
9. Analyze the quality and implications of medical literature and apply new knowledge in the delivery of health care,
10. Identify and participate in future areas of inquiry in medical research,
11. Express enthusiasm and positive attitude in the educational process and participate fully in educational and research activities.

SUBJECT SPECIFIC COMPETENCIES

By the end of the course, the student should have acquired knowledge (cognitive domain), professionalism (affective domain) and skills (psychomotor domain) as per details given below:

(A) Cognitive Domain

At the end of the course, the student should be able to:

1. Use the aspects of applied Anatomy, Physiology, Biochemistry and Pharmacology for daily practice,
2. Plan and implement resuscitation and initial management of the acutely ill patients,
3. Perform diagnosis, assessment, investigation, monitoring and data interpretation of the actively ill patients,
4. Manage critical care in secondary and advanced care facilities,
5. Implement therapeutic interventions/organ system support in single or multiple organ failure,
6. Organise peri-operative care,
7. Supervise critical care of children,
8. Offer support for care in transfer of critically ill patients,
9. Organise Clinical Measurement,
10. Plan and execute Research in related fields,
11. Organise infection control in ICU,
12. Discuss safety for patients & staff in ICU,
13. Exhibit good understanding of critical incidents, adverse events, complications related to ICU care,
14. Organise multi-disciplinary case conference and counseling sessions with family,
15. Discuss and explain critical appraisal and application of guidelines, protocols and care bundles
16. Demonstrate understanding of scoring systems for assessment of severity of illness and case mix,

17. Demonstrate good understanding of the managerial & administrative responsibilities of the critical care specialist.

(B) Affective Domain

1. Comfort, Pain-Relief and Recovery

- 1.1 Understanding of the physical and psychosocial consequences of critical illness for patients and families and methods of prevention and management
- 1.2 Communication of the continuing care requirements of patients at ICU discharge to health care professionals, patients and relatives

2. End of Life Care

- 2.1. Management of the process of withholding or withdrawing treatment with the multidisciplinary team
- 2.2. Discussion of the end of life care with patients and their families/surrogates

3. Health Systems Management

- 3.1. Leadership in daily multidisciplinary ward round

4. Ethics, Attitudes and Professionalism

Communication skills

- 4.1. Communication with patients and relatives
- 4.2. Communication with members of the health care team

Professional relationships with patients and relatives

- 4.3. Involvement with patients (or their surrogates) in decision making
- 4.4. Understanding of cultural and religious beliefs and an awareness of their impact on decision making
- 4.5. Understanding of privacy, dignity, confidentiality and legal constraints on the use of patient data

Professional relationships with members of the health care team

- 4.6. Collaboration, consultation, team work
- 4.7. Supervision and delegation of duties and responsibilities to others

(C) Psychomotor Domain

At the end of the course, the student should have acquired skills in the following:

1. Respiratory system

- 1.1. Oxygen therapy - Fundamental principles and ICU specific issues
- 1.2. Fiberoptic laryngoscopy
- 1.3. Emergency airway management

- 1.4. Difficult and failed airway management
 - 1.5. Endotracheal suction
 - 1.6. Fiberoptic bronchoscopy and BAL in the intubated patient
 - 1.7. Percutaneous tracheostomy and mini-tracheostomy
 - 1.8. Thoracocentesis via a chest drain
- 2. Cardiovascular system**
- 2.1. Peripheral venous catheterization
 - 2.2. Arterial catheterization
 - 2.3. Surgical isolation of vein/artery
 - 2.4. Ultrasound techniques for vascular localization
 - 2.5. Central venous catheterization
 - 2.6. Defibrillation and cardioversion
 - 2.7. Cardiac pacing (transvenous or transthoracic)
 - 2.8. Fundamentals of pericardiocentesis
 - 2.9. Measurement of cardiac output and derived haemodynamic variable
- 3. Central Nervous System**
- 3.1. Lumbar puncture (intradural/spinal)
 - 3.2. Basic understanding of neuraxial pain medication like epidural analgesia
- 4. Gastrointestinal System**
- 4.1. Nasogastric tube placement
 - 4.2. Abdominal paracentesis
 - 4.3. Sengstaken tube (or equivalent) placement
 - 4.4. Fundamentals of upper GI endoscopy
 - 4.5. Measurement and interpretation of intra-abdominal pressure
- 5. Genitourinary System**
- 5.1. Urinary catheterization

SYLLABUS

Course contents:

- 1. Resuscitation and Initial Management of the Acutely Ill Patients**
 - 1.1 Timely approach to the recognition, assessment and stabilization of the acutely ill patients with disordered physiology
 - 1.2 Cardiopulmonary resuscitation
 - 1.3 Post-resuscitation management
 - 1.4 Triage and prioritization of patients for ICU admission
 - 1.5 Assessment and initial management of the trauma patient
 - 1.6 Assessment and initial management of the patient with burns
 - 1.7 Fundamentals of the management of mass casualties

2. Diagnosis: Assessment, Investigation, Monitoring and Data: Interpretation of the acutely ill patients

- 2.1 History taking and clinical examination
- 2.2 Timely and appropriate investigations
- 2.3 Understanding of echocardiography (trans-thoracic/trans-oesophageal), Indications and interpretation of results
- 2.4 Understanding of Electrocardiography (ECG/EKG), Indications and interpretation of the results
- 2.5 Appropriate microbiological sampling and interpretation of results
- 2.6 Interpretation of results from blood gas samples
- 2.7 Organization and interpretation of wide range of clinical imaging including bed-side chest x- rays, ultrasound, CT scan, MRI and nuclear imaging relevant for the diagnosis and management of critically ill and injured patients.
- 2.8 Understanding and interpretation of physiological variables
- 2.9 Integration of clinical findings with laboratory, radiology, microbiology and other investigations to form appropriate differential diagnosis and management strategy

3. Disease Management

Acute disease

- 3.1 Management of the care of the critically ill patient with following specific acute medical conditions
 - Acute Myocardial Infarction
 - Pulmonary Embolism
 - Cardiogenic Shock
 - Life Threatening Arrhythmias
 - Pericardial Tamponade
 - Acute Ischemic Stroke
 - Intracranial Hemorrhage
 - Status Epilepticus
 - Head & Spine Trauma
 - Acute neuromuscular failure (OPP/GBS/MG/Snakebite, etc)
 - Acute severe Asthma
 - Acute Exacerbation of COPD
 - Severe Community acquired pneumonia
 - Chest Trauma
 - Acute hypoxemia Respiratory Failure including ARDS
 - Acute GI Bleed
 - Acute Liver Failure
 - Acute Pancreatitis
 - Acute Abdomen
 - Acute coagulation disorders
 - Sepsis and Septicemic Shock
 - Meningitis

- Acute Hemorrhagic Fevers
- Severe forms of tropical infections like Malaria, Typhoid etc.
- Acute Renal Failure
- Eclampsia
- Bone marrow suppression
- Critical care of mother and child including pre-eclampsia, eclampsia, acute fatty liver of pregnancy, HELLP syndrome, meconium aspiration syndrome, respiratory distress syndrome, transient tachypnoea of the newborn etc.
- Acute poisoning

Chronic Disease

- 3.2 Identifications of the implications of chronic and co morbid disease in the acutely ill patients

Organ System Failure

- 3.3 Management of patients with or at risk of circulatory failure
- 3.4 Management of patients with or at risk of acute renal failure
- 3.5 Management of patients with or at risk of acute liver failure
- 3.6 Management of patients with or at risk of neurological impairment
- 3.7 Management of patients with or at risk of acute gastrointestinal failure
- 3.8 Management of patients with or at risk of acute lung injury syndromes (ALI/ARDS)
- 3.9 Management of patients with or at risk of septic shock
- 3.10 Management of patients with or at risk of severe sepsis/septic shock with multi-organ dysfunction/failure
- 3.11 Management of patients following intoxication with drugs or environmental toxins
- 3.12 Early recognition and treatment of life-threatening complications, in mother and child, including but not limited to like eclampsia, preeclampsia, acute fatty liver of pregnancy, HELLP in mother and respiratory distress in child.

4. Therapeutic Interventions/Organ System Support in Single or Multiple Organ Failure

- 4.1 Principles of safe prescription
- 4.2 Principles of safe delivery of life-support therapies
- 4.3 Antimicrobial drug therapy – Fundamental principles and ICU specific issues
- 4.4 Transfusion therapy - Fundamental principles and ICU specific issues
- 4.5 Circulatory therapies - Fundamental principles and ICU specific issues pertaining to Fluid therapy including dynamic variables of fluid responsiveness and vasoactive/inotropic drugs
- 4.6 Mechanical circulatory assist devices
- 4.7 Initiation, management and weaning of the patients from invasive and non-invasive ventilatory support
- 4.8 Initiation, management and weaning of the patients from renal replacement therapy
- 4.9 Management of electrolyte, glucose and acid-base disturbances
- 4.10 Nutritional assessment and support

5. Peri-operative Care

- 5.1 Management of the pre- & post-operative care of the high risk surgical patients
- 5.2 Fundamentals of the management of the care of patients following cardiac surgery
- 5.3 Fundamentals of the management of the patients following craniotomy
- 5.4 Fundamentals of the management of the patients following solid organ transplantation
- 5.5 Fundamentals of the management of the pre and post-operative trauma care of the trauma patients

6. Critical Care of Children

- 6.1 Understanding of the critical care of children including but not limited to early diagnosis, initial management and life support therapies related to pediatric and neonatal emergencies

7. Transportation

- 7.1 Transportation of the mechanically ventilated critically ill patient outside the ICU
- 7.2 Understanding of the special considerations required during patient transport by air

8. Physical & Clinical Measurement

Mathematical Concepts:

- 8.1 Relationships and graphs
- 8.2 Concepts of exponential functions and logarithms: wash-in and washout
- 8.3 Basic measurement concepts: linearity, drift, hysteresis, signal: noise ratio, static and dynamic response
- 8.4 SI units: fundamental and derived units
- 8.5 Other systems of units where relevant to ICM (e.g. mmHg, bar, atmospheres)
- 8.6 Simple mechanics: Mass, Force, Work and Power

Gases & Vapours:

- 8.7 Absolute and relative pressure.
- 8.8 The gas laws; triple point; critical temperature and pressure
- 8.9 Density and viscosity of gases.
- 8.10 Laminar and turbulent flow; Poiseuille's equation, the Bernoulli principle
- 8.11 Vapour pressure: saturated vapour pressure
- 8.12 Measurement of volume and flow in gases and liquids.
- 8.13 The pneumotachograph and other respirometers.
- 8.14 Principles of surface tension

Electricity & Magnetism:

- 8.15 Basic concepts of electricity, magnetism and Bridge circuits
- 8.16 Capacitance, inductance and impedance
- 8.17 Amplifiers: bandwidth, filters
- 8.18 Amplification of biological potentials: ECG, EMG, EEG.
- 8.19 Sources of electrical interference

8.20 Processing, storage and display of physiological measurements

Electrical Safety:

8.21 Principles of cardiac pacemakers and defibrillators

8.22 Electrical hazards: causes and prevention.

8.23 Electrocutation, fires and explosions.

8.24 Diathermy and its safe use

8.25 Basic principles and safety of lasers

8.26 Basic principles of ultrasound and the Doppler effect

Pressure & Flow Monitoring:

8.27 Principles of pressure transducers

8.28 Resonance and damping, frequency response

8.29 Measurement and units of pressure.

8.30 Direct and indirect methods of blood pressure measurement; arterial curve analysis

8.31 Principles of pulmonary artery and wedge pressure measurement

8.32 Cardiac output: Fick principle, thermodilution

Clinical Measurement:

8.33 Measurement of gas and vapour concentrations, (oxygen, carbon dioxide, nitrous oxide, and volatile anaesthetic agents) using infrared, paramagnetic, fuel cell, oxygen electrode and mass spectrometry methods

8.34 Measurement of H⁺, pH, pCO₂, pO₂

8.35 Measurement CO₂ production/ oxygen consumption/ respiratory quotient

8.36 Colligative properties: osmometry

8.37 Simple tests of pulmonary function e.g. peak flow measurement, spirometry.

8.38 Capnography

8.39 Pulse oximetry

8.40 Measurement of neuromuscular blockade

8.41 Measurement of pain

9. Research Methods

Data Collection:

9.1 Simple aspects of study design (research question, selection of the method of investigation, population, intervention, outcome measures)

9.2 Power analysis

9.3 Defining the outcome measures and the uncertainty of measuring them

9.4 The basic concept of meta-analysis and evidence-based medicine

Descriptive Statistics:

9.5 Types of data and their representation

- 9.6 The normal distribution as an example of parametric distribution
- 9.7 Indices of central tendency and variability

Deductive & Inferential Statistics:

- 9.8 Simple probability theory and the relation to confidence intervals
- 9.9 The null hypothesis.
- 9.10 Choice of simple statistical tests for different data types
- 9.11 Type I and type II errors
- 9.12 Inappropriate use of statistics

10. Applied Anatomy

Respiratory System:

- 10.1 Mouth, nose, pharynx, larynx, trachea, main bronchi, segmental bronchi, structure of bronchial tree and differences in the children's airway
- 10.2 Airway and respiratory tract, blood supply, innervation and lymphatic drainage
- 10.3 Pleura, mediastinum and its contents
- 10.4 Lungs, lobes, microstructure of lungs
- 10.5 Diaphragm, other muscles of respiration, innervation
- 10.6 The thoracic inlet and 1st rib
- 10.7 Interpretation of a chest x-ray

Cardiovascular System:

- 10.8 Heart, chambers, conducting system, blood and nerve supply
- 10.9 Congenital deviations from normal anatomy
- 10.10 Pericardium
- 10.11 Great vessels, main peripheral arteries and veins
- 10.12 Foetal and maternal-foetal circulation

Nervous System:

- 10.13 Brain and its subdivisions
- 10.14 Spinal cord, structure of spinal cord, major ascending & descending pathways
- 10.15 Spinal meninges, subarachnoid & extradural space, extradural space-contents
- 10.16 Cerebral blood supply
- 10.17 CSF and its circulation
- 10.18 Spinal nerves, dermatomes
- 10.19 Brachial plexus, nerves of arm
- 10.20 Intercostal nerves
- 10.21 Nerves of abdominal wall
- 10.22 Nerves of leg and foot

- 10.23 Autonomic nervous system
- 10.24 Sympathetic innervation, sympathetic chain, ganglia and plexuses
- 10.25 Parasympathetic innervation.
- 10.26 Stellate ganglion
- 10.27 Cranial nerves: base of skull: trigeminal ganglion
- 10.28 Innervation of the larynx
- 10.29 Eye and orbit

Vertebral Column:

- 10.30 Cervical, thoracic, and lumbar vertebrae
- 10.31 Interpretation of cervical spinal imaging in trauma
- 10.32 Sacrum, sacral hiatus
- 10.33 Ligaments of vertebral column
- 10.34 Surface anatomy of vertebral spaces, length of cord in child and adult

Surface Anatomy:

- 10.35 Structures in antecubital fossa
- 10.36 Structures in axilla: identifying the brachial plexus
- 10.37 Large veins and anterior triangle of neck
- 10.38 Large veins of leg and femoral triangle
- 10.39 Arteries of arm and leg
- 10.40 Landmarks for tracheostomy, cricothyrotomy
- 10.41 Abdominal wall (including the inguinal region): landmarks for suprapubic urinary and peritoneal lavage catheters
- 10.42 Landmarks for intrapleural drains and emergency pleurocentesis
- 10.43 Landmarks for pericardiocentesis

Abdomen:

- 10.44 Gross anatomy of intra-abdominal organs
- 10.45 Blood supply to abdominal organs and lower body

11. Physiology & Biochemistry

General:

- 11.1 Organisation of the human body and homeostasis
- 11.2 Variations with age
- 11.3 Function of cells; genes and their expression
- 11.4 Mechanisms of cellular and humoral defense
- 11.5 Cell membrane characteristics; receptors
- 11.6 Protective mechanisms of the body

11.7 Genetics & disease processes

Biochemistry:

11.8 Acid base balance and buffers, Ions e.g. Na, K, Ca, Cl, HCO₃, Mg, PO₄,

11.9 Enzymes and Cellular and intermediary metabolism

Body Fluids:

11.10 Capillary dynamics and interstitial fluid

11.11 Oncotic pressure

11.12 Osmolarity: osmolality, partition of fluids across membranes

11.13 Lymphatic system

11.14 Special fluids: cerebrospinal, pleural, pericardial and peritoneal fluids

Haematology & Immunology:

11.15 Red blood cells: haemoglobin and its variants

11.16 Blood groups

11.17 Haemostasis and coagulation; pathological variations

11.18 White blood cells

11.19 Inflammation and its disorders

11.20 Immunity and allergy

Muscle:

11.21 Action potential generation and its transmission

11.22 Neuromuscular junction and transmission

11.23 Muscle types

11.24 Skeletal muscle contraction

11.25 Motor unit

11.26 Muscle wasting

11.27 Smooth muscle contraction: sphincters

Heart & Circulation:

11.28 Cardiac muscle contraction

11.29 The cardiac cycle: pressure and volume relationships

11.30 Rhythmicity of the heart

11.31 Regulation of cardiac function; general and cellular

11.32 Control of cardiac output (including the Starling relationship)

11.33 Fluid challenge and heart failure

11.34 Electrocardiogram and arrhythmias

- 11.35 Neurological and humoral control of systemic blood pressures, blood volume and blood flow (at rest and during physiological disturbances e.g. exercise, haemorrhage and Valsalva manoeuvre)
- 11.36 Peripheral circulation: capillaries, vascular endothelium and arteriolar smooth muscle, autoregulation and the effects of sepsis and the inflammatory response on the peripheral vasculature
- 11.37 Characteristics of special circulations including: pulmonary, coronary, cerebral, renal, portal and foetal

Renal Tract:

- 11.38 Blood flow, glomerular filtration and plasma clearance
- 11.39 Tubular function and urine formation
- 11.40 Endocrine functions of kidney
- 11.41 Assessment of renal function
- 11.42 Regulation of fluid and electrolyte balance
- 11.43 Regulation of acid-base balance
- 11.44 Micturition
- 11.45 Pathophysiology of acute renal failure

Respiration:

- 11.46 Gaseous exchange: O₂ and CO₂ transport, hypoxia and hyper- and hypocapnia, hyperandhypobaric pressures
- 11.47 Functions of haemoglobin in oxygen carriage and acid-base equilibrium
- 11.48 Pulmonary ventilation: volumes, flows, dead space.
- 11.49 Effect of IPPV and PEEP on lungs and circulation
- 11.50 Mechanics of ventilation: ventilation/perfusion abnormalities
- 11.51 Control of breathing, acute and chronic ventilatory failure, effect of oxygen therapy
- 11.52 Non-respiratory functions of the lungs
- 11.53 Cardio-respiratory interactions in health & disease

Nervous System:

- 11.54 Functions of nerve cells: action potentials, conduction, synaptic mechanisms and transmitters
- 11.55 The brain: functional divisions
- 11.56 Intracranial pressure: cerebrospinal fluid, blood flow
- 11.57 Maintenance of posture
- 11.58 Autonomic nervous system: functions
- 11.59 Neurological reflexes Motor function: spinal and peripheral
- 11.60 Senses: receptors, nociception, special senses

- 11.61 Pain: afferent nociceptive pathways, dorsal horn, peripheral and central mechanisms, neuromodulatory systems, supraspinal mechanisms, visceral pain, neuropathic pain, influence of therapy on nociceptive mechanisms
11.62 Spinal cord: anatomy and blood supply, effects of spinal cord section

Liver:

- 11.63 Functional anatomy and blood supply
11.64 Metabolic functions
11.65 Tests of function

Gastrointestinal:

- 11.66 Gastric function; secretions, nausea and vomiting
11.67 Gut motility, sphincters and reflex control
11.68 Digestive functions and enzymes
11.69 Nutrition: calories, nutritional fuels and sources, trace elements, growth factors

Metabolism and Nutrition:

- 11.70 Nutrients: carbohydrates, fats, proteins, vitamins, minerals and trace elements
11.71 Metabolic pathways, energy production and enzymes; metabolic rate
11.72 Hormonal control of metabolism: regulation of plasma glucose, response to trauma
11.73 Physiological alterations in starvation, obesity, exercise and the stress response
11.74 Body temperature and its regulation

Endocrinology:

- 11.75 Mechanisms of hormonal control: feedback mechanisms, effect on membrane and intracellular receptors
11.76 Central neuro-endocrine interactions
11.77 Adrenocortical hormones
11.78 Adrenal medulla: adrenaline (epinephrine) and noradrenaline (norepinephrine)
11.79 Pancreas: insulin, glucagon and exocrine function
11.80 Thyroid and parathyroid hormones and calcium homeostasis

Physiology and Metabolism Unique to Pregnancy, Child Birth and Neonates:

- 11.81 Physiological changes associated with a normal pregnancy and delivery
11.82 Materno-foetal, foetal and neonatal circulation
11.83 Functions of the placenta: placental transfer
11.84 Foetus: changes at birth
11.85 Metabolism unique to pregnant mother and neonates

12. Pharmacology

Principles of Pharmacology:

- 12.1 Dynamics of drug-receptor interaction
- 12.2 Agonists, antagonists, partial agonists, inverse agonists
- 12.3 Efficacy and potency
- 12.4 Tolerance
- 12.5 Receptor function and regulation
- 12.6 Metabolic pathways; enzymes; drug: enzyme interactions; Michaelis-Menten equation
- 12.7 Enzyme inducers and inhibitors.
- 12.8 Mechanisms of drug action Ion channels: types: relation to receptors.
- 12.9 Gating mechanisms.
- 12.10 Signal transduction: cell membrane/receptors/ion channels to intracellular molecular targets, second messengers
- 12.11 Action of gases and vapours
- 12.12 Osmotic effects
- 12.13 pH effects
- 12.14 Adsorption and chelation
- 12.15 Mechanisms of drug interactions:
- 12.16 Inhibition and promotion of drug uptake.
- 12.17 Competitive protein binding.
- 12.18 Receptor inter-actions.
- 12.19 Effects of metabolites and other degradation products.

Pharmacokinetics & Pharmacodynamics

- 12.20 Drug uptake from: gastrointestinal tract, lungs, nasal, transdermal, subcutaneous, IM, IV, epidural and intrathecal routes
- 12.21 Bioavailability
- 12.22 Factors determining the distribution of drugs: perfusion, molecular size, solubility, protein binding.
- 12.23 The influence of drug formulation on disposition
- 12.24 Distribution of drugs to organs and tissues:
- 12.25 Body compartments Influence of specialised membranes: tissue binding and solubility
- 12.26 Materno-foetal distribution
- 12.27 Distribution in CSF and extradural space
- 12.28 Modes of drug elimination:
- 12.29 Direct excretion
- 12.30 Metabolism in organs of excretion: phase I & II mechanisms
- 12.31 Renal excretion and urinary H
- 12.32 Non-organ breakdown of Drugs

- 12.33 Pharmacokinetic analysis:
- 12.34 Concept of a pharmacokinetic compartment
- 12.35 Apparent volume of distribution
- 12.36 Orders of kinetics
- 12.37 Clearance concepts applied to whole body and individual organs
- 12.38 Simple 1 and 2 compartmental models:
- 12.39 Concepts of wash-in and washout curves
- 12.40 Physiological models based on perfusion and partition coefficients
- 12.41 Effect of organ blood flow: Fick principle
- 12.42 Pharmacokinetic variation: influence of body size, sex, age, disease, pregnancy, anaesthesia, trauma, surgery, smoking, alcohol and other drugs
- 12.43 Effects of acute organ failure (liver, kidney) on drug elimination Influence of renal replacement therapies on clearance of commonly used drugs
- 12.44 Pharmacodynamics: concentration-effect relationships: hysteresis
- 12.45 Pharmacogenetics: familial variation in drug response
- 12.46 Adverse reactions to drugs: hypersensitivity, allergy, anaphylaxis, anaphylactoid reactions

Systemic Pharmacology

- 12.47 Hypnotics, sedatives and intravenous anaesthetic agents
- 12.48 Simple analgesics
- 12.49 Opioids and other analgesics; Opioid antagonists
- 12.50 Non-steroidal anti-inflammatory drugs
- 12.51 Neuromuscular blocking agents (depolarising and non-depolarising) and anti cholinesterases
- 12.52 Drugs acting on the autonomic nervous system (including inotropes, vasodilators vasoconstrictors, antiarrhythmics, diuretics)
- 12.53 Drugs acting on the respiratory system (including respiratory stimulants and bronchodilators)
- 12.54 Antihypertensives
- 12.55 Anticonvulsants
- 12.56 Anti-diabetic agents
- 12.57 Diuretics
- 12.58 Antibiotics
- 12.59 Corticosteroids and other hormone preparations
- 12.60 Antacids. Drugs influencing gastric secretion and motility
- 12.61 Antiemetic agents
- 12.62 Local anaesthetic agents
- 12.63 Immunosuppressants
- 12.64 Principles of therapy based on modulation of inflammatory mediators, indications, actions and limitations
- 12.65 Plasma volume expanders
- 12.66 Antihistamines

- 12.67 Antidepressants
- 12.68 Anticoagulants
- 12.69 Vitamins and trace elements

TEACHING AND LEARNING METHODS

Teaching and learning methodology given below includes but not limited to Lecture, discussion, student directed learning and Case Based Learning.

1. Clinical Case Discussion
2. Morbidity-Mortality Discussion
3. Audit presentation
4. Lectures, Seminars and Journal Clubs
5. Presentation of progress report on the research projects
6. Simulation Laboratory
7. Joint inter-departmental academic meets with radiology, microbiology etc.
8. Departmental Clinical Meetings, Grand Rounds and Clinico-Pathological Meetings
9. Multi-departmental Combined Grand Rounds / Joint Academic Activities of the Institution

Formal Teaching:

- a) **Journal Club:** 1 hour duration - Paper presentation/discussion - once per week.
- b) **Seminar:** One seminar every week of one hour duration.
- c) **Lecture/discussion:** Lectures on newer topics by faculty, in place of seminar as per need.
- d) **Case presentation** in the ward. Post graduate students will present a clinical case for discussion before a faculty and discussion made pertaining to its management and decision to be recorded in case files.
- e) **Case conference:** Post graduate students are expected to work up one long case or two short cases and present the same to a faculty member and discuss the management.
- h) **Combined Round/Grand Round:** These exercises are to be done for the hospital once a week or twice a month involving presentation of unusual or difficult cases. Presentation of cases in clinical combined/grand rounds and clinical series/research

data for the benefit of all clinicians and other related disciplines once in week or fortnightly.

- i) **Emergency situation:** Casualty duty to be arranged by rotation among the students with a faculty cover daily by rotation.
- j). Bedside clinical training for patient care management. Daily for half to one hour during ward round with faculty and 1-2 hours in the evening by post graduate students /faculty on emergency duty, bed side patient care discussions are to be made.
- k). Clinical teaching: In OPD, ward rounds, emergency, ICU and the operation theatres.
- l) PG students shall be required to participate in the teaching and training programme of Undergraduate students and interns.
- m) Should have attended two conferences/CMEs/Workshops during tenure.
- n) A postgraduate student of a postgraduate degree course in broad specialities/super specialities would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.
- o) **LOG BOOK**
Postgraduate students shall maintain a log book of the work carried out by them and the training programme undergone during the period of training including details of surgical operations assisted or done independently by M.Ch. trainees. Log book shall be checked and assessed periodically by the faculty members imparting the training.
- p) The Department should encourage e-learning activities.

q) Clinical and Practical Training/posting:

Teaching and training of students shall include graded all round patient care responsibilities including resuscitation, clinical diagnosis, invasive diagnostic and therapeutic procedures and advanced decision making in the management of critically sick medical and surgical patients.

To achieve these objectives, the postgraduate students would be asked to spend their time in the following manner:

A. Twenty-four months in core discipline i.e. Intensive Care Units of the Department of Critical Care Medicine

Maximum of 12 months of need-based rotation in other disciplines like Internal Medicine, Cardiology, Nephrology, Neurology, Medical Gastroenterology, Endocrinology, Medical Oncology, Immunology, Anaesthesiology, Trauma and Emergency Care and Intensive Care Units of other disciplines/hospitals to cover up any deficiency in the required case-mix for the purpose of DM in CCM.

- B. Wherever the case-mix is deficient either in surgical and medical patients, the deficiency must be fulfilled by intra-hospital or inter-hospital ICU rotation of the trainees in such units/departments which are running MCI recognized MD/MS or DM/MCh courses.

During the training programme, patient safety is of paramount importance; therefore, skills are to be learnt initially and later to be performed under supervision followed by performing independently. Provision of skills laboratories for cardiopulmonary resuscitation in the medical colleges is mandatory.

ASSESSMENT

FORMATIVE ASSESSMENT

Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system.

Periodic Evaluation:

Trainees will be evaluated continuously for their performance in all areas such as clinical and investigative work, case presentations, seminars, journal clubs, procedures etc. Additional periodic assessment will include theory and practical assessment mimicking the final examination should be conducted every 6 months. Such an evaluation will help assessing the progress of the trainees and the quality of the training programme. Evaluation will be communicated to trainees and their feedback would be taken into consideration for modifications in training programme.

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

Quarterly assessment during the DM training should be based on:

- 1. Journal based / recent advances learning**
- 2. Patient based /Laboratory or Skill based learning**
- 3. Self directed learning and teaching**
- 4. Departmental and interdepartmental learning activity**
- 5. External and Outreach Activities / CMEs**

The student to be assessed periodically as per categories listed in Postgraduate Student Appraisal form (Annexure I).

SUMMATIVE ASSESSMENT

The summative examination would be carried out as per the Rules given in POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.

The summative assessment examination shall include two heads:

- A. Theory examination.
- B. Practical, Clinical examination and Viva-voce.

Theory examination and Practical/Clinical, Viva-voce shall be separate heads of passing.

Theory examination shall comprise of four papers. Passing percentage shall be cumulatively 50% with minimum of 40% marks in each theory paper.

Practical /Clinical examination consisting of at least one long case, three short cases and viva-voce. Passing percentage shall be 50%.

Passing shall be separate for each head and failing shall be common, meaning thereby that –clearance at theory and failure at practical / clinical shall amount to failure at Summative examination and vice versa.

1. **Theory:** There shall be four theory papers:

Paper I: Basic Medical Sciences related to Critical Care Medicine
Paper II: Clinical - Etiology, diagnosis and treatment of acute life-threatening

- Paper III: medical and surgical diseases related to Critical Care Medicine
Clinical - Procedures, interventions, professionalism, ethics and research
Methods related to Critical Care Medicine
- Paper IV: Recent Advances in the field of Critical Care Medicine

2. **Practical:**

The practical examination should consist of the following and should be spread over two days. One long case: History taking, physical examination, interpretation of clinical findings, differential diagnosis, investigations, prognosis and management. Three short cases from various sections of the specialty.

- Stations for clinical, procedural and communication skills
- Log Book Records and day-to-day observation during the training

3. **Viva-voce Examination:** covering affective and cognitive domain. This may include a pedagogic session as well.

Feedback:

- Feedback should be given to the trainees on regular basis.
- The feedback should be about the overall integrated, coherent and longitudinal assessment of the trainee.
- The feedback should be in the form of constructive suggestions for improvement in their performance.

Assessment shall be carried by supervising teachers with focus on:

- 1 Acquisition and application of knowledge and skills
- 2 Clinical reasoning and judgment in uncertain situations
- 3 Problem solving skills - Situation/Problem Based Learning
- 4 Skill development for diagnostic and therapeutic procedures
- 5 All above through departmental and extra department rotation

Recommended reading:

Text Books (latest edition)

1. Textbook of Critical Care (Elsevier)
2. Oxford Textbook of Critical Care (Oxford University Press)
3. Critical Care Medicine: Principles of Diagnosis and Management in the Adult (Mosby)
4. Irwin and Rippe's Intensive Care Medicine (LWW)

5. Oh's Intensive Care Manual (Butterworth-Heinemann)
6. Textbook of Critical Care: Common Problems in the ICU Access Code (Saunders)
7. Evidence-Based Practice of Critical Care (Elsevier)
8. Principles and Practice of Mechanical Ventilation (Tobin, Principles and Practice of Mechanical Ventilation) (McGraw-Hill Education / Medical)
9. West's Respiratory Physiology: The Essentials (LWW)
10. Manual of ICU Procedures (Jaypee Hights Medical Pub Inc)
11. Harrison's Principles of Internal Medicine (McGraw-Hill Education/Medical)

➤ **Journals:**

3-5 international and two national journals (all indexed)



Postgraduate Student Appraisal Form

Clinical Disciplines

Name of the Department/Unit :
 Name of the PG Student :
 Period of Training : FROM.....TO.....

Sr. No.	PARTICULARS	Not Satisfactory			Satisfactory			More Than Satisfactory			Remarks
		1	2	3	4	5	6	7	8	9	
1.	Journal based / recent advances learning										
2.	Patient based /Laboratory or Skill based learning										
3.	Self directed learning and teaching										
4.	Departmental and interdepartmental learning activity										
5.	External and Outreach Activities / CMEs										
6.	Thesis / Research work										
7.	Log Book Maintenance										

Publications

Yes/ No

Remarks* _____

***REMARKS: Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.**

SIGNATURE OF ASSESSEE SIGNATURE OF CONSULTANT SIGNATURE OF HOD



**BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE**

**Faculty of Medical Sciences
DM - Critical Care Medicine
Old Syllabus**

COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR DM IN CRITICAL CARE MEDICINE

Preamble

Competency based postgraduate training programme for DM in Critical Care Medicine aims to produce a postgraduate student who after undergoing the required training should be able to deal effectively with the needs of the community and should be competent to handle all basic problems. The postgraduate students must gain ample of knowledge and experience in the diagnosis and treatment of patients with acute, serious, and life-threatening medical and surgical diseases. He / She should also acquire skills in supervision of paramedical staff and be able to work as a team member of the health care providers. He / She should be aware of his/her limitations and should be able to decide the point of referral.

The core components of clinical services of the specialty of Critical Care Medicine (CCM) or Intensive Care Medicine, as is known in many countries, revolves around life-support therapies under one roof to critically sick patients (medical, surgical and trauma etc.) who are admitted in the hospital area commonly named as General Adult Intensive Care Unit (ICU) (also known as General Adult Critical Care Unit -CCU) but specialists in Critical Care Medicine are responsible to take care of any of the critically sick patient admitted in any of the wards of the hospital.

Need Based Assessment of Course

DM in Critical Care Medicine (CCM) is a newly instituted postgraduate training programme in India and requires strategic planning for successful inception and growth. and the course is known as In the specialty of CCM, due to the convergence of knowledge and skills with the involvement of various primary specialties, there has been flexibility in the models of training, access, duration of training, regulation and certification systems across the globe. Trauma is an increasingly important problem affecting young individuals. Critical Care will be required to intensively monitor patients in trauma and to manage serious infections with multi-organ dysfunction.

At the end of training in CCM, the post graduate student should have acquired the following knowledge and skills:

1. General and specialist aspects of critical care, including management of the service,
2. Supervision of long-term collaborative management plans for larger number of patients,
3. Leadership for ICU team,
4. Teaching and supervision of junior colleagues,
5. Integration of information,
6. Effective functioning of critical care service within wider environments of case-mix,
7. Ability to plan professional development as a contribution to the holistic growth of specialty including patient care, teaching/training and research.

The trainee must gain experience in the diagnosis and treatment of patients with acute, serious, and life-threatening medical and surgical diseases. The curriculum of three-year training in Critical Care Medicine deals with the cognitive, psychomotor and affective domains covering following learning objectives:

SUBJECT SPECIFIC OBJECTIVES

The specific objectives of the course are:

1. Perform resuscitation and management of the acutely ill adult and pediatric patients,
2. Plan and organize therapeutic interventions/organ system support in single or multiple organ failure in conditions associated with trauma, burns, infections, metabolic derangements etc.
3. Plan end of life care,
4. Organize peri-operative care of surgical / trauma patients,
5. Plan and execute infection control procedures, system management and standard operative procedures in the Intensive (critical) Care Units,
6. Operate the monitoring gadgets and to detect and manage alterations in their functioning,
7. Communicate effectively and empathetically to patients and attendants, about the critical nature of illnesses, end of life care and breaking bad news in contingencies,

8. Lead and be a member of the team involved in critical care,
9. Analyze the quality and implications of medical literature and apply new knowledge in the delivery of health care,
10. Identify and participate in future areas of inquiry in medical research,
11. Express enthusiasm and positive attitude in the educational process and participate fully in educational and research activities.

SUBJECT SPECIFIC COMPETENCIES

By the end of the course, the student should have acquired knowledge (cognitive domain), professionalism (affective domain) and skills (psychomotor domain) as per details given below:

(A) Cognitive Domain

At the end of the course, the student should be able to:

1. Use the aspects of applied Anatomy, Physiology, Biochemistry and Pharmacology for daily practice,
2. Plan and implement resuscitation and initial management of the acutely ill patients,
3. Perform diagnosis, assessment, investigation, monitoring and data interpretation of the actively ill patients,
4. Manage critical care in secondary and advanced care facilities,
5. Implement therapeutic interventions/organ system support in single or multiple organ failure,
6. Organise peri-operative care,
7. Supervise critical care of children,
8. Offer support for care in transfer of critically ill patients,
9. Organise Clinical Measurement,
10. Plan and execute Research in related fields,
11. Organise infection control in ICU,
12. Discuss safety for patients & staff in ICU,
13. Exhibit good understanding of critical incidents, adverse events, complications related to ICU care,
14. Organise multi-disciplinary case conference and counseling sessions with family,
15. Discuss and explain critical appraisal and application of guidelines, protocols and care bundles
16. Demonstrate understanding of scoring systems for assessment of severity of illness and case mix,

17. Demonstrate good understanding of the managerial & administrative responsibilities of the critical care specialist.

(B) Affective Domain

1. Comfort, Pain-Relief and Recovery

- 1.1 Understanding of the physical and psychosocial consequences of critical illness for patients and families and methods of prevention and management
- 1.2 Communication of the continuing care requirements of patients at ICU discharge to health care professionals, patients and relatives

2. End of Life Care

- 2.1. Management of the process of withholding or withdrawing treatment with the multidisciplinary team
- 2.2. Discussion of the end of life care with patients and their families/surrogates

3. Health Systems Management

- 3.1. Leadership in daily multidisciplinary ward round

4. Ethics, Attitudes and Professionalism

Communication skills

- 4.1. Communication with patients and relatives
- 4.2. Communication with members of the health care team

Professional relationships with patients and relatives

- 4.3. Involvement with patients (or their surrogates) in decision making
- 4.4. Understanding of cultural and religious beliefs and an awareness of their impact on decision making
- 4.5. Understanding of privacy, dignity, confidentiality and legal constraints on the use of patient data

Professional relationships with members of the health care team

- 4.6. Collaboration, consultation, team work
- 4.7. Supervision and delegation of duties and responsibilities to others

(C) Psychomotor Domain

At the end of the course, the student should have acquired skills in the following:

1. Respiratory system

- 1.1. Oxygen therapy - Fundamental principles and ICU specific issues
- 1.2. Fiberoptic laryngoscopy
- 1.3. Emergency airway management

- 1.4. Difficult and failed airway management
 - 1.5. Endotracheal suction
 - 1.6. Fiberoptic bronchoscopy and BAL in the intubated patient
 - 1.7. Percutaneous tracheostomy and mini-tracheostomy
 - 1.8. Thoracocentesis via a chest drain
- 2. Cardiovascular system**
- 2.1. Peripheral venous catheterization
 - 2.2. Arterial catheterization
 - 2.3. Surgical isolation of vein/artery
 - 2.4. Ultrasound techniques for vascular localization
 - 2.5. Central venous catheterization
 - 2.6. Defibrillation and cardioversion
 - 2.7. Cardiac pacing (transvenous or transthoracic)
 - 2.8. Fundamentals of pericardiocentesis
 - 2.9. Measurement of cardiac output and derived haemodynamic variable
- 3. Central Nervous System**
- 3.1. Lumbar puncture (intradural/spinal)
 - 3.2. Basic understanding of neuraxial pain medication like epidural analgesia
- 4. Gastrointestinal System**
- 4.1. Nasogastric tube placement
 - 4.2. Abdominal paracentesis
 - 4.3. Sengstaken tube (or equivalent) placement
 - 4.4. Fundamentals of upper GI endoscopy
 - 4.5. Measurement and interpretation of intra-abdominal pressure
- 5. Genitourinary System**
- 5.1. Urinary catheterization

SYLLABUS

Course contents:

- 1. Resuscitation and Initial Management of the Acutely Ill Patients**
 - 1.1 Timely approach to the recognition, assessment and stabilization of the acutely ill patients with disordered physiology
 - 1.2 Cardiopulmonary resuscitation
 - 1.3 Post-resuscitation management
 - 1.4 Triage and prioritization of patients for ICU admission
 - 1.5 Assessment and initial management of the trauma patient
 - 1.6 Assessment and initial management of the patient with burns
 - 1.7 Fundamentals of the management of mass casualties

2. Diagnosis: Assessment, Investigation, Monitoring and Data: Interpretation of the acutely ill patients

- 2.1 History taking and clinical examination
- 2.2 Timely and appropriate investigations
- 2.3 Understanding of echocardiography (trans-thoracic/trans-oesophageal), Indications and interpretation of results
- 2.4 Understanding of Electrocardiography (ECG/EKG), Indications and interpretation of the results
- 2.5 Appropriate microbiological sampling and interpretation of results
- 2.6 Interpretation of results from blood gas samples
- 2.7 Organization and interpretation of wide range of clinical imaging including bed-side chest x- rays, ultrasound, CT scan, MRI and nuclear imaging relevant for the diagnosis and management of critically ill and injured patients.
- 2.8 Understanding and interpretation of physiological variables
- 2.9 Integration of clinical findings with laboratory, radiology, microbiology and other investigations to form appropriate differential diagnosis and management strategy

3. Disease Management

Acute disease

- 3.1 Management of the care of the critically ill patient with following specific acute medical conditions
 - Acute Myocardial Infarction
 - Pulmonary Embolism
 - Cardiogenic Shock
 - Life Threatening Arrhythmias
 - Pericardial Tamponade
 - Acute Ischemic Stroke
 - Intracranial Hemorrhage
 - Status Epilepticus
 - Head & Spine Trauma
 - Acute neuromuscular failure (OPP/GBS/MG/Snakebite, etc)
 - Acute severe Asthma
 - Acute Exacerbation of COPD
 - Severe Community acquired pneumonia
 - Chest Trauma
 - Acute hypoxemia Respiratory Failure including ARDS
 - Acute GI Bleed
 - Acute Liver Failure
 - Acute Pancreatitis
 - Acute Abdomen
 - Acute coagulation disorders
 - Sepsis and Septicemic Shock
 - Meningitis

- Acute Hemorrhagic Fevers
- Severe forms of tropical infections like Malaria, Typhoid etc.
- Acute Renal Failure
- Eclampsia
- Bone marrow suppression
- Critical care of mother and child including pre-eclampsia, eclampsia, acute fatty liver of pregnancy, HELLP syndrome, meconium aspiration syndrome, respiratory distress syndrome, transient tachypnoea of the newborn etc.
- Acute poisoning

Chronic Disease

- 3.2 Identifications of the implications of chronic and co morbid disease in the acutely ill patients

Organ System Failure

- 3.3 Management of patients with or at risk of circulatory failure
- 3.4 Management of patients with or at risk of acute renal failure
- 3.5 Management of patients with or at risk of acute liver failure
- 3.6 Management of patients with or at risk of neurological impairment
- 3.7 Management of patients with or at risk of acute gastrointestinal failure
- 3.8 Management of patients with or at risk of acute lung injury syndromes (ALI/ARDS)
- 3.9 Management of patients with or at risk of septic shock
- 3.10 Management of patients with or at risk of severe sepsis/septic shock with multi-organ dysfunction/failure
- 3.11 Management of patients following intoxication with drugs or environmental toxins
- 3.12 Early recognition and treatment of life-threatening complications, in mother and child, including but not limited to like eclampsia, preeclampsia, acute fatty liver of pregnancy, HELLP in mother and respiratory distress in child.

4. Therapeutic Interventions/Organ System Support in Single or Multiple Organ Failure

- 4.1 Principles of safe prescription
- 4.2 Principles of safe delivery of life-support therapies
- 4.3 Antimicrobial drug therapy – Fundamental principles and ICU specific issues
- 4.4 Transfusion therapy - Fundamental principles and ICU specific issues
- 4.5 Circulatory therapies - Fundamental principles and ICU specific issues pertaining to Fluid therapy including dynamic variables of fluid responsiveness and vasoactive/inotropic drugs
- 4.6 Mechanical circulatory assist devices
- 4.7 Initiation, management and weaning of the patients from invasive and non-invasive ventilatory support
- 4.8 Initiation, management and weaning of the patients from renal replacement therapy
- 4.9 Management of electrolyte, glucose and acid-base disturbances
- 4.10 Nutritional assessment and support

5. Peri-operative Care

- 5.1 Management of the pre- & post-operative care of the high risk surgical patients
- 5.2 Fundamentals of the management of the care of patients following cardiac surgery
- 5.3 Fundamentals of the management of the patients following craniotomy
- 5.4 Fundamentals of the management of the patients following solid organ transplantation
- 5.5 Fundamentals of the management of the pre and post-operative trauma care of the trauma patients

6. Critical Care of Children

- 6.1 Understanding of the critical care of children including but not limited to early diagnosis, initial management and life support therapies related to pediatric and neonatal emergencies

7. Transportation

- 7.1 Transportation of the mechanically ventilated critically ill patient outside the ICU
- 7.2 Understanding of the special considerations required during patient transport by air

8. Physical & Clinical Measurement

Mathematical Concepts:

- 8.1 Relationships and graphs
- 8.2 Concepts of exponential functions and logarithms: wash-in and washout
- 8.3 Basic measurement concepts: linearity, drift, hysteresis, signal: noise ratio, static and dynamic response
- 8.4 SI units: fundamental and derived units
- 8.5 Other systems of units where relevant to ICM (e.g. mmHg, bar, atmospheres)
- 8.6 Simple mechanics: Mass, Force, Work and Power

Gases & Vapours:

- 8.7 Absolute and relative pressure.
- 8.8 The gas laws; triple point; critical temperature and pressure
- 8.9 Density and viscosity of gases.
- 8.10 Laminar and turbulent flow; Poiseuille's equation, the Bernoulli principle
- 8.11 Vapour pressure: saturated vapour pressure
- 8.12 Measurement of volume and flow in gases and liquids.
- 8.13 The pneumotachograph and other respirometers.
- 8.14 Principles of surface tension

Electricity & Magnetism:

- 8.15 Basic concepts of electricity, magnetism and Bridge circuits
- 8.16 Capacitance, inductance and impedance
- 8.17 Amplifiers: bandwidth, filters
- 8.18 Amplification of biological potentials: ECG, EMG, EEG.
- 8.19 Sources of electrical interference

8.20 Processing, storage and display of physiological measurements

Electrical Safety:

8.21 Principles of cardiac pacemakers and defibrillators

8.22 Electrical hazards: causes and prevention.

8.23 Electrocutation, fires and explosions.

8.24 Diathermy and its safe use

8.25 Basic principles and safety of lasers

8.26 Basic principles of ultrasound and the Doppler effect

Pressure & Flow Monitoring:

8.27 Principles of pressure transducers

8.28 Resonance and damping, frequency response

8.29 Measurement and units of pressure.

8.30 Direct and indirect methods of blood pressure measurement; arterial curve analysis

8.31 Principles of pulmonary artery and wedge pressure measurement

8.32 Cardiac output: Fick principle, thermodilution

Clinical Measurement:

8.33 Measurement of gas and vapour concentrations, (oxygen, carbon dioxide, nitrous oxide, and volatile anaesthetic agents) using infrared, paramagnetic, fuel cell, oxygen electrode and mass spectrometry methods

8.34 Measurement of H⁺, pH, pCO₂, pO₂

8.35 Measurement CO₂ production/ oxygen consumption/ respiratory quotient

8.36 Colligative properties: osmometry

8.37 Simple tests of pulmonary function e.g. peak flow measurement, spirometry.

8.38 Capnography

8.39 Pulse oximetry

8.40 Measurement of neuromuscular blockade

8.41 Measurement of pain

9. Research Methods

Data Collection:

9.1 Simple aspects of study design (research question, selection of the method of investigation, population, intervention, outcome measures)

9.2 Power analysis

9.3 Defining the outcome measures and the uncertainty of measuring them

9.4 The basic concept of meta-analysis and evidence-based medicine

Descriptive Statistics:

9.5 Types of data and their representation

- 9.6 The normal distribution as an example of parametric distribution
- 9.7 Indices of central tendency and variability

Deductive & Inferential Statistics:

- 9.8 Simple probability theory and the relation to confidence intervals
- 9.9 The null hypothesis.
- 9.10 Choice of simple statistical tests for different data types
- 9.11 Type I and type II errors
- 9.12 Inappropriate use of statistics

10. Applied Anatomy

Respiratory System:

- 10.1 Mouth, nose, pharynx, larynx, trachea, main bronchi, segmental bronchi, structure of bronchial tree and differences in the children's airway
- 10.2 Airway and respiratory tract, blood supply, innervation and lymphatic drainage
- 10.3 Pleura, mediastinum and its contents
- 10.4 Lungs, lobes, microstructure of lungs
- 10.5 Diaphragm, other muscles of respiration, innervation
- 10.6 The thoracic inlet and 1st rib
- 10.7 Interpretation of a chest x-ray

Cardiovascular System:

- 10.8 Heart, chambers, conducting system, blood and nerve supply
- 10.9 Congenital deviations from normal anatomy
- 10.10 Pericardium
- 10.11 Great vessels, main peripheral arteries and veins
- 10.12 Foetal and maternal-foetal circulation

Nervous System:

- 10.13 Brain and its subdivisions
- 10.14 Spinal cord, structure of spinal cord, major ascending & descending pathways
- 10.15 Spinal meninges, subarachnoid & extradural space, extradural space-contents
- 10.16 Cerebral blood supply
- 10.17 CSF and its circulation
- 10.18 Spinal nerves, dermatomes
- 10.19 Brachial plexus, nerves of arm
- 10.20 Intercostal nerves
- 10.21 Nerves of abdominal wall
- 10.22 Nerves of leg and foot

- 10.23 Autonomic nervous system
- 10.24 Sympathetic innervation, sympathetic chain, ganglia and plexuses
- 10.25 Parasympathetic innervation.
- 10.26 Stellate ganglion
- 10.27 Cranial nerves: base of skull: trigeminal ganglion
- 10.28 Innervation of the larynx
- 10.29 Eye and orbit

Vertebral Column:

- 10.30 Cervical, thoracic, and lumbar vertebrae
- 10.31 Interpretation of cervical spinal imaging in trauma
- 10.32 Sacrum, sacral hiatus
- 10.33 Ligaments of vertebral column
- 10.34 Surface anatomy of vertebral spaces, length of cord in child and adult

Surface Anatomy:

- 10.35 Structures in antecubital fossa
- 10.36 Structures in axilla: identifying the brachial plexus
- 10.37 Large veins and anterior triangle of neck
- 10.38 Large veins of leg and femoral triangle
- 10.39 Arteries of arm and leg
- 10.40 Landmarks for tracheostomy, cricothyrotomy
- 10.41 Abdominal wall (including the inguinal region): landmarks for suprapubic urinary and peritoneal lavage catheters
- 10.42 Landmarks for intrapleural drains and emergency pleurocentesis
- 10.43 Landmarks for pericardiocentesis

Abdomen:

- 10.44 Gross anatomy of intra-abdominal organs
- 10.45 Blood supply to abdominal organs and lower body

11. Physiology & Biochemistry

General:

- 11.1 Organisation of the human body and homeostasis
- 11.2 Variations with age
- 11.3 Function of cells; genes and their expression
- 11.4 Mechanisms of cellular and humoral defense
- 11.5 Cell membrane characteristics; receptors
- 11.6 Protective mechanisms of the body

11.7 Genetics & disease processes

Biochemistry:

11.8 Acid base balance and buffers, Ions e.g. Na, K, Ca, Cl, HCO₃, Mg, PO₄,

11.9 Enzymes and Cellular and intermediary metabolism

Body Fluids:

11.10 Capillary dynamics and interstitial fluid

11.11 Oncotic pressure

11.12 Osmolarity: osmolality, partition of fluids across membranes

11.13 Lymphatic system

11.14 Special fluids: cerebrospinal, pleural, pericardial and peritoneal fluids

Haematology & Immunology:

11.15 Red blood cells: haemoglobin and its variants

11.16 Blood groups

11.17 Haemostasis and coagulation; pathological variations

11.18 White blood cells

11.19 Inflammation and its disorders

11.20 Immunity and allergy

Muscle:

11.21 Action potential generation and its transmission

11.22 Neuromuscular junction and transmission

11.23 Muscle types

11.24 Skeletal muscle contraction

11.25 Motor unit

11.26 Muscle wasting

11.27 Smooth muscle contraction: sphincters

Heart & Circulation:

11.28 Cardiac muscle contraction

11.29 The cardiac cycle: pressure and volume relationships

11.30 Rhythmicity of the heart

11.31 Regulation of cardiac function; general and cellular

11.32 Control of cardiac output (including the Starling relationship)

11.33 Fluid challenge and heart failure

11.34 Electrocardiogram and arrhythmias

- 11.35 Neurological and humoral control of systemic blood pressures, blood volume and blood flow (at rest and during physiological disturbances e.g. exercise, haemorrhage and Valsalva manoeuvre)
- 11.36 Peripheral circulation: capillaries, vascular endothelium and arteriolar smooth muscle, autoregulation and the effects of sepsis and the inflammatory response on the peripheral vasculature
- 11.37 Characteristics of special circulations including: pulmonary, coronary, cerebral, renal, portal and foetal

Renal Tract:

- 11.38 Blood flow, glomerular filtration and plasma clearance
- 11.39 Tubular function and urine formation
- 11.40 Endocrine functions of kidney
- 11.41 Assessment of renal function
- 11.42 Regulation of fluid and electrolyte balance
- 11.43 Regulation of acid-base balance
- 11.44 Micturition
- 11.45 Pathophysiology of acute renal failure

Respiration:

- 11.46 Gaseous exchange: O₂ and CO₂ transport, hypoxia and hyper- and hypocapnia, hyperandhypobaric pressures
- 11.47 Functions of haemoglobin in oxygen carriage and acid-base equilibrium
- 11.48 Pulmonary ventilation: volumes, flows, dead space.
- 11.49 Effect of IPPV and PEEP on lungs and circulation
- 11.50 Mechanics of ventilation: ventilation/perfusion abnormalities
- 11.51 Control of breathing, acute and chronic ventilatory failure, effect of oxygen therapy
- 11.52 Non-respiratory functions of the lungs
- 11.53 Cardio-respiratory interactions in health & disease

Nervous System:

- 11.54 Functions of nerve cells: action potentials, conduction, synaptic mechanisms and transmitters
- 11.55 The brain: functional divisions
- 11.56 Intracranial pressure: cerebrospinal fluid, blood flow
- 11.57 Maintenance of posture
- 11.58 Autonomic nervous system: functions
- 11.59 Neurological reflexes Motor function: spinal and peripheral
- 11.60 Senses: receptors, nociception, special senses

- 11.61 Pain: afferent nociceptive pathways, dorsal horn, peripheral and central mechanisms, neuromodulatory systems, supraspinal mechanisms, visceral pain, neuropathic pain, influence of therapy on nociceptive mechanisms
11.62 Spinal cord: anatomy and blood supply, effects of spinal cord section

Liver:

- 11.63 Functional anatomy and blood supply
11.64 Metabolic functions
11.65 Tests of function

Gastrointestinal:

- 11.66 Gastric function; secretions, nausea and vomiting
11.67 Gut motility, sphincters and reflex control
11.68 Digestive functions and enzymes
11.69 Nutrition: calories, nutritional fuels and sources, trace elements, growth factors

Metabolism and Nutrition:

- 11.70 Nutrients: carbohydrates, fats, proteins, vitamins, minerals and trace elements
11.71 Metabolic pathways, energy production and enzymes; metabolic rate
11.72 Hormonal control of metabolism: regulation of plasma glucose, response to trauma
11.73 Physiological alterations in starvation, obesity, exercise and the stress response
11.74 Body temperature and its regulation

Endocrinology:

- 11.75 Mechanisms of hormonal control: feedback mechanisms, effect on membrane and intracellular receptors
11.76 Central neuro-endocrine interactions
11.77 Adrenocortical hormones
11.78 Adrenal medulla: adrenaline (epinephrine) and noradrenaline (norepinephrine)
11.79 Pancreas: insulin, glucagon and exocrine function
11.80 Thyroid and parathyroid hormones and calcium homeostasis

Physiology and Metabolism Unique to Pregnancy, Child Birth and Neonates:

- 11.81 Physiological changes associated with a normal pregnancy and delivery
11.82 Materno-foetal, foetal and neonatal circulation
11.83 Functions of the placenta: placental transfer
11.84 Foetus: changes at birth
11.85 Metabolism unique to pregnant mother and neonates

12. Pharmacology

Principles of Pharmacology:

- 12.1 Dynamics of drug-receptor interaction
- 12.2 Agonists, antagonists, partial agonists, inverse agonists
- 12.3 Efficacy and potency
- 12.4 Tolerance
- 12.5 Receptor function and regulation
- 12.6 Metabolic pathways; enzymes; drug: enzyme interactions; Michaelis-Menten equation
- 12.7 Enzyme inducers and inhibitors.
- 12.8 Mechanisms of drug action Ion channels: types: relation to receptors.
- 12.9 Gating mechanisms.
- 12.10 Signal transduction: cell membrane/receptors/ion channels to intracellular molecular targets, second messengers
- 12.11 Action of gases and vapours
- 12.12 Osmotic effects
- 12.13 pH effects
- 12.14 Adsorption and chelation
- 12.15 Mechanisms of drug interactions:
- 12.16 Inhibition and promotion of drug uptake.
- 12.17 Competitive protein binding.
- 12.18 Receptor inter-actions.
- 12.19 Effects of metabolites and other degradation products.

Pharmacokinetics & Pharmacodynamics

- 12.20 Drug uptake from: gastrointestinal tract, lungs, nasal, transdermal, subcutaneous, IM, IV, epidural and intrathecal routes
- 12.21 Bioavailability
- 12.22 Factors determining the distribution of drugs: perfusion, molecular size, solubility, protein binding.
- 12.23 The influence of drug formulation on disposition
- 12.24 Distribution of drugs to organs and tissues:
- 12.25 Body compartments Influence of specialised membranes: tissue binding and solubility
- 12.26 Materno-foetal distribution
- 12.27 Distribution in CSF and extradural space
- 12.28 Modes of drug elimination:
- 12.29 Direct excretion
- 12.30 Metabolism in organs of excretion: phase I & II mechanisms
- 12.31 Renal excretion and urinary H
- 12.32 Non-organ breakdown of Drugs

- 12.33 Pharmacokinetic analysis:
- 12.34 Concept of a pharmacokinetic compartment
- 12.35 Apparent volume of distribution
- 12.36 Orders of kinetics
- 12.37 Clearance concepts applied to whole body and individual organs
- 12.38 Simple 1 and 2 compartmental models:
- 12.39 Concepts of wash-in and washout curves
- 12.40 Physiological models based on perfusion and partition coefficients
- 12.41 Effect of organ blood flow: Fick principle
- 12.42 Pharmacokinetic variation: influence of body size, sex, age, disease, pregnancy, anaesthesia, trauma, surgery, smoking, alcohol and other drugs
- 12.43 Effects of acute organ failure (liver, kidney) on drug elimination Influence of renal replacement therapies on clearance of commonly used drugs
- 12.44 Pharmacodynamics: concentration-effect relationships: hysteresis
- 12.45 Pharmacogenetics: familial variation in drug response
- 12.46 Adverse reactions to drugs: hypersensitivity, allergy, anaphylaxis, anaphylactoid reactions

Systemic Pharmacology

- 12.47 Hypnotics, sedatives and intravenous anaesthetic agents
- 12.48 Simple analgesics
- 12.49 Opioids and other analgesics; Opioid antagonists
- 12.50 Non-steroidal anti-inflammatory drugs
- 12.51 Neuromuscular blocking agents (depolarising and non-depolarising) and anti cholinesterases
- 12.52 Drugs acting on the autonomic nervous system (including inotropes, vasodilators vasoconstrictors, antiarrhythmics, diuretics)
- 12.53 Drugs acting on the respiratory system (including respiratory stimulants and bronchodilators)
- 12.54 Antihypertensives
- 12.55 Anticonvulsants
- 12.56 Anti-diabetic agents
- 12.57 Diuretics
- 12.58 Antibiotics
- 12.59 Corticosteroids and other hormone preparations
- 12.60 Antacids. Drugs influencing gastric secretion and motility
- 12.61 Antiemetic agents
- 12.62 Local anaesthetic agents
- 12.63 Immunosuppressants
- 12.64 Principles of therapy based on modulation of inflammatory mediators, indications, actions and limitations
- 12.65 Plasma volume expanders
- 12.66 Antihistamines

- 12.67 Antidepressants
- 12.68 Anticoagulants
- 12.69 Vitamins and trace elements

TEACHING AND LEARNING METHODS

Teaching and learning methodology given below includes but not limited to Lecture, discussion, student directed learning and Case Based Learning.

1. Clinical Case Discussion
2. Morbidity-Mortality Discussion
3. Audit presentation
4. Lectures, Seminars and Journal Clubs
5. Presentation of progress report on the research projects
6. Simulation Laboratory
7. Joint inter-departmental academic meets with radiology, microbiology etc.
8. Departmental Clinical Meetings, Grand Rounds and Clinico-Pathological Meetings
9. Multi-departmental Combined Grand Rounds / Joint Academic Activities of the Institution

Formal Teaching:

- a) **Journal Club:** 1 hour duration - Paper presentation/discussion - once per week.
- b) **Seminar:** One seminar every week of one hour duration.
- c) **Lecture/discussion:** Lectures on newer topics by faculty, in place of seminar as per need.
- d) **Case presentation** in the ward. Post graduate students will present a clinical case for discussion before a faculty and discussion made pertaining to its management and decision to be recorded in case files.
- e) **Case conference:** Post graduate students are expected to work up one long case or two short cases and present the same to a faculty member and discuss the management.
- h) **Combined Round/Grand Round:** These exercises are to be done for the hospital once a week or twice a month involving presentation of unusual or difficult cases. Presentation of cases in clinical combined/grand rounds and clinical series/research

data for the benefit of all clinicians and other related disciplines once in week or fortnightly.

- i) **Emergency situation:** Casualty duty to be arranged by rotation among the students with a faculty cover daily by rotation.
- j). Bedside clinical training for patient care management. Daily for half to one hour during ward round with faculty and 1-2 hours in the evening by post graduate students /faculty on emergency duty, bed side patient care discussions are to be made.
- k). Clinical teaching: In OPD, ward rounds, emergency, ICU and the operation theatres.
- l) PG students shall be required to participate in the teaching and training programme of Undergraduate students and interns.
- m) Should have attended two conferences/CMEs/Workshops during tenure.
- n) A postgraduate student of a postgraduate degree course in broad specialities/super specialities would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.
- o) **LOG BOOK**
Postgraduate students shall maintain a log book of the work carried out by them and the training programme undergone during the period of training including details of surgical operations assisted or done independently by M.Ch. trainees. Log book shall be checked and assessed periodically by the faculty members imparting the training.
- p) The Department should encourage e-learning activities.

q) Clinical and Practical Training/posting:

Teaching and training of students shall include graded all round patient care responsibilities including resuscitation, clinical diagnosis, invasive diagnostic and therapeutic procedures and advanced decision making in the management of critically sick medical and surgical patients.

To achieve these objectives, the postgraduate students would be asked to spend their time in the following manner:

A. Twenty-four months in core discipline i.e. Intensive Care Units of the Department of Critical Care Medicine

Maximum of 12 months of need-based rotation in other disciplines like Internal Medicine, Cardiology, Nephrology, Neurology, Medical Gastroenterology, Endocrinology, Medical Oncology, Immunology, Anaesthesiology, Trauma and Emergency Care and Intensive Care Units of other disciplines/hospitals to cover up any deficiency in the required case-mix for the purpose of DM in CCM.

- B. Wherever the case-mix is deficient either in surgical and medical patients, the deficiency must be fulfilled by intra-hospital or inter-hospital ICU rotation of the trainees in such units/departments which are running MCI recognized MD/MS or DM/MCh courses.

During the training programme, patient safety is of paramount importance; therefore, skills are to be learnt initially and later to be performed under supervision followed by performing independently. Provision of skills laboratories for cardiopulmonary resuscitation in the medical colleges is mandatory.

ASSESSMENT

FORMATIVE ASSESSMENT

Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self directed learning and ability to practice in the system.

Periodic Evaluation:

Trainees will be evaluated continuously for their performance in all areas such as clinical and investigative work, case presentations, seminars, journal clubs, procedures etc. Additional periodic assessment will include theory and practical assessment mimicking the final examination should be conducted every 6 months. Such an evaluation will help assessing the progress of the trainees and the quality of the training programme. Evaluation will be communicated to trainees and their feedback would be taken into consideration for modifications in training programme.

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

Quarterly assessment during the DM training should be based on:

- 1. Journal based / recent advances learning**
- 2. Patient based /Laboratory or Skill based learning**
- 3. Self directed learning and teaching**
- 4. Departmental and interdepartmental learning activity**
- 5. External and Outreach Activities / CMEs**

The student to be assessed periodically as per categories listed in Postgraduate Student Appraisal form (Annexure I).

SUMMATIVE ASSESSMENT

The summative examination would be carried out as per the Rules given in POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.

The summative assessment examination shall include two heads:

- A. Theory examination.
- B. Practical, Clinical examination and Viva-voce.

Theory examination and Practical/Clinical, Viva-voce shall be separate heads of passing.

Theory examination shall comprise of four papers. Passing percentage shall be cumulatively 50% with minimum of 40% marks in each theory paper.

Practical /Clinical examination consisting of at least one long case, three short cases and viva-voce. Passing percentage shall be 50%.

Passing shall be separate for each head and failing shall be common, meaning thereby that –clearance at theory and failure at practical / clinical shall amount to failure at Summative examination and vice versa.

1. **Theory:** There shall be four theory papers:

Paper I: Basic Medical Sciences related to Critical Care Medicine
Paper II: Clinical - Etiology, diagnosis and treatment of acute life-threatening

Paper III:	medical and surgical diseases related to Critical Care Medicine Clinical - Procedures, interventions, professionalism, ethics and research Methods related to Critical Care Medicine
Paper IV:	Recent Advances in the field of Critical Care Medicine

2. **Practical:**

The practical examination should consist of the following and should be spread over two days. One long case: History taking, physical examination, interpretation of clinical findings, differential diagnosis, investigations, prognosis and management. Three short cases from various sections of the specialty.

- Stations for clinical, procedural and communication skills
- Log Book Records and day-to-day observation during the training

3. **Viva-voce Examination:** covering affective and cognitive domain. This may include a pedagogic session as well.

Feedback:

- Feedback should be given to the trainees on regular basis.
- The feedback should be about the overall integrated, coherent and longitudinal assessment of the trainee.
- The feedback should be in the form of constructive suggestions for improvement in their performance.

Assessment shall be carried by supervising teachers with focus on:

- 1 Acquisition and application of knowledge and skills
- 2 Clinical reasoning and judgment in uncertain situations
- 3 Problem solving skills - Situation/Problem Based Learning
- 4 Skill development for diagnostic and therapeutic procedures
- 5 All above through departmental and extra department rotation

Recommended reading:

Text Books (latest edition)

1. Textbook of Critical Care (Elsevier)
2. Oxford Textbook of Critical Care (Oxford University Press)
3. Critical Care Medicine: Principles of Diagnosis and Management in the Adult (Mosby)
4. Irwin and Rippe's Intensive Care Medicine (LWW)

5. Oh's Intensive Care Manual (Butterworth-Heinemann)
6. Textbook of Critical Care: Common Problems in the ICU Access Code (Saunders)
7. Evidence-Based Practice of Critical Care (Elsevier)
8. Principles and Practice of Mechanical Ventilation (Tobin, Principles and Practice of Mechanical Ventilation) (McGraw-Hill Education / Medical)
9. West's Respiratory Physiology: The Essentials (LWW)
10. Manual of ICU Procedures (Jaypee Hights Medical Pub Inc)
11. Harrison's Principles of Internal Medicine (McGraw-Hill Education/Medical)

➤ **Journals:**

3-5 international and two national journals (all indexed)



Postgraduate Student Appraisal Form

Clinical Disciplines

Name of the Department/Unit :
 Name of the PG Student :
 Period of Training : FROM.....TO.....

Sr. No.	PARTICULARS	Not Satisfactory			Satisfactory			More Than Satisfactory			Remarks
		1	2	3	4	5	6	7	8	9	
1.	Journal based / recent advances learning										
2.	Patient based /Laboratory or Skill based learning										
3.	Self directed learning and teaching										
4.	Departmental and interdepartmental learning activity										
5.	External and Outreach Activities / CMEs										
6.	Thesis / Research work										
7.	Log Book Maintenance										

Publications

Yes/ No

Remarks* _____

***REMARKS:** Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.

SIGNATURE OF ASSESSEE SIGNATURE OF CONSULTANT SIGNATURE OF HOD