



SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai - 400058



(Working Professional) **END SEMESTER EXAMINATION MAY/JUNE 2026**

Third Year B.Tech W.P

Program: Mechanical Engineering

Duration: 03 hr

Course Code: **PE-BTM 613**

Maximum Points: 100

Course Name: **Tool Engineering**

Semester: VI

Notes:

25/05/2026

- Each main question carries 20 marks, attempt any 5 questions.
- Wherever necessary assume suitable data and draw well labeled diagram/graph.

Q.No.	Questions	Pt	CO	BL	Module
Q1 A	Using Necessary sketch show the following; a. Feed Engagement b. Back Engagement c. Uncut chip thickness d. Major cutting-edge angle for OD turning and face turning operation? Write a short note on cutting strain using sketch and required expression?	10	1	1	1
B	Prove that specific cutting pressure in an ideal orthogonal cutting is $\frac{F_c}{A} = 2 \times \tau \times \cot \phi$ If following condition is satisfied as " $2\phi + \beta - \gamma = (\pi/2)$ ". ϕ is shear angle, β is mean friction angle and γ is rake angle of cutting tool.	10	2	2	1
Q2 A	Enlist benefits of conversion of tool angles? Give Tool signatures and nomenclature meaning for orthogonal rake system, normal rake system and machine rake system?	10	1	1	2
B	Obtain expression for maximum rake angle (as a function of rake angles in ORS system) and inclination of master line? Explain Master line principle for conversion of tool angles?	10	1	2	2
Q3 A	What are primary and secondary Functions of cutting Fluids? Write short note on any one type of cutting fluids?	10	2	1	3
B	Give the important design requirements of cutting force dynamometer? Draw neat sketch of turning dynamometer?	10	2	1	3



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B	Explain the different geometric consideration in rolling operation to be taken care in respect of the roll and the workpiece geometry using the sketch? If the flatness of steel metal or the straightness of rod to be corrected, using the sketch give the solution?	10	3	2	4
Q5 A	Discuss about all the design and manufacturing aspects of die button and punch systems in details using sketch only?	10	4	1	5
B	Draw the neat sketch for the punched hole and punched slug in detail using the sketch? Identify list problems associated with the punched hole and slug and how to overcome this using setup? Name it and explain?	10	3	1	5
Q6 A	Among the casted, machined and forged component which is more reliable and possesses good mechanical properties, justify why? Write short note on hot forging process using sketch?	10	3	2	6
B	Explain any 2 forging operations using sketch?	10	4	1	6
Q7 A	What is strain rate sensitivity, explain it using neat sketch? What is strain rate? B] Write a short note Elongation? How strain hardening exponent strain rate sensitivity is important for elongation & what is its desirable condition?	10	4	1	7
B	What is Minimum bend radius for sheetmetal? Discuss about Factors affecting Bendability and Solution?	10	4	2	7



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END SEMSTER /RE-EXAMINATION, TERM-II, A.Y. 2025-26

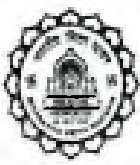
Program: B.Tech. Mechanical (WP) *Third Year B.Tech W.P* Duration: 3 Hours
Course Code: PCC-BTM 602 Maximum Points: 100
Course Name: Thermal and Fluid Machines Semester: VI

Notes:

- 1) Solve: Any FIVE Questions.
- 2) Write **SPECIFIC** answers and in legible handwriting.
- 3) Draw neat system diagram / process diagrams/ neat sketches wherever asked or necessary.
- 4) Assume suitable data wherever necessary and state the same.

28/05/2026

Q. No.	Question	Points	CO	BL	Module	PL															
1.	a) Explain: Working, Advantages and disadvantages of a two-stage compressor with perfect intercooling. Derive: Expression for minimum compressor work for the same. Draw: Neat system and p-V diagrams.	10	2	II, III, V	1	1.4.1															
	b) The following data refers to a testing of a single acting compressor: <table><tr><td>Bore and stroke (cm)</td><td>14 x 10</td><td>Discharge temp.</td><td>180°C</td></tr><tr><td>Suction pressure</td><td>1 bar</td><td>Compressor Speed</td><td>1200 rpm</td></tr><tr><td>Suction temp.</td><td>20°C</td><td>Shaft power</td><td>6.25 kW</td></tr><tr><td>Discharge pressure</td><td>6 bar</td><td>Mass of air delivered (kg/min)</td><td>1.7</td></tr></table> Evaluate: i) The actual volumetric efficiency ii) Indicated power iii) Isothermal efficiency iv) Mechanical efficiency of the compressor. Draw: p-V Diagram for the working of compressor.	Bore and stroke (cm)	14 x 10	Discharge temp.	180°C	Suction pressure	1 bar	Compressor Speed	1200 rpm	Suction temp.	20°C	Shaft power	6.25 kW	Discharge pressure	6 bar	Mass of air delivered (kg/min)	1.7	10	4	III, VI	1
Bore and stroke (cm)	14 x 10	Discharge temp.	180°C																		
Suction pressure	1 bar	Compressor Speed	1200 rpm																		
Suction temp.	20°C	Shaft power	6.25 kW																		
Discharge pressure	6 bar	Mass of air delivered (kg/min)	1.7																		
2.	a) Draw: Neat system diagram and T-s diagram of a closed cycle gas turbine plant. Derive: Expression for its air standard efficiency. Explain: i) Work ratio and ii) Air rate.	07	2, 3	II, III, V	6	1.4.1															



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END SEMSTER /RE-EXAMINATION, TERM-II, A.Y. 2025-26

	b) Explain: i) Thermal efficiency ii) Mechanical efficiency and iii) Specific fuel consumption for an I.C. Engine. Compare: S.I. and C.I. Engines with respect to at least 04 criterion.	07	1	II, IV	3,4	1.4.1												
	c) For a single stage reciprocating air compressor, Explain the following terms: i) Clearance ratio ii) Volumetric efficiency iii) Isentropic efficiency iv) Isothermal efficiency v) Mechanical efficiency, vi) Free air delivery.	06	1	II	1	1.4.1												
3.	a) Explain: Construction of a typical S.I. Engines with features and functions of its at least 04 main parts. Draw: Neat sketch.	08	2	II, III	3	1.4.1.												
	b) In a Morse test of a four cylinder, four stroke petrol engine having a bore of 75 mm and a stroke of 100 mm, following results were obtained with a fixed setting of fuel supply of 6 kg/h: B.P. with all four cylinders working: 15.6 kW B.P. with cylinder no. 1 cut off: 11.1 kW B.P. with cylinder no. 2 cut off: 11.03 kW B.P. with cylinder no. 3 cut off: 10.88 kW B.P. with cylinder no. 4 cut off: 10.66 kW If the calorific value of the fuel is 83600 kJ/kg and clearance volume is 0.0001m ³ , Evaluate: i) Mechanical efficiency ii) Indicated thermal efficiency and iii) Air standard efficiency of the engine.	12	4	VI	3	1.4.1												
4.	a) Explain: Phenomenon of combustion in C.I. engines with stages involved. Draw: Neat p- θ diagram.	08	2, 3	II, III	4	1.4.1												
	b) In a trial on a single cylinder diesel engine with compression ratio of 15, following observations were obtained: <table border="1"><tr><td>Fuel Consumption</td><td>10.2 kg/h</td><td>Cooling water flow</td><td>15.5 kg/min</td></tr><tr><td>Calorific value</td><td>43890 kJ/ kg</td><td>Temp. rise of cooling water</td><td>36°C</td></tr><tr><td>Air consumption</td><td>3.8 kg/min</td><td>Exhaust gas temp.</td><td>410°C</td></tr></table>	Fuel Consumption	10.2 kg/h	Cooling water flow	15.5 kg/min	Calorific value	43890 kJ/ kg	Temp. rise of cooling water	36°C	Air consumption	3.8 kg/min	Exhaust gas temp.	410°C	12	4	V, VI	4	1.4.1
Fuel Consumption	10.2 kg/h	Cooling water flow	15.5 kg/min															
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	Speed	1900 rpm	Room temperature	20°C					
	Torque on brake drum	186 m.N	c_p of exhaust gases (kJ/kg.K)	1.17					
	Evaluate: i) Brake power ii) Brake specific fuel consumption iii) Brake thermal efficiency of the engine. Prepare: Heat balance sheet for the engine in kJ/min and percentage.								
5.	a) Discuss: Classification of steam generators on the basis of at least 05 criterion of classification. State: At least one example of each type. Compare: Fire tube and water tube boilers w.r.t. at least 05 points.				10	1	I,II, IV	5	1.4.1
	b) Discuss: At least 03 unique features of high pressure boilers. Explain: Working of Benson boiler. Draw: Neat system diagram.				10	2	II, III	5	1.4.1
6.	a) State: Methods of improving efficiency of a simple gas turbine plant. Explain: Reheating for open cycle gas turbine plant. Draw: Neat system diagram and T-s diagram.				08	2	I,II, III	6	1.4.1
	b) The pressure ratio of an open cycle gas turbine power plant is 5.6. Air is taken at 30°C and 1 bar. The compression is carried out in two stages with perfect intercooling in between the two stages. The maximum temperature of the cycle is limited to 700°C. Assuming the isentropic efficiency of each compressor stage as 85% and that of the turbine as 90%, Evaluate: i) the power developed and ii) efficiency of the power plant, if the air-fuel ratio is 1.2 kg/s. The mass fuel may be neglected. c_p of air = 1.02 kJ /kg.K and $\gamma = 1.41$. Draw: Neat system diagram and T-s diagram.				12	4	III, VI	1,6	1.4.1
7.	a) Describe: Working of a centrifugal pump with Constructional features and functions of its main parts. Draw: Neat sketch.				10	1	II, III	2	1.4.1
	b) Describe: Working of a Pelton turbine with Constructional features and functions of its main parts. Draw: Neat sketch.				10	1	II, III	7	1.4.1



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End Semester Examination May-2026/Re-Exam July 2026 (WP)

Program: B. Tech Mechanical (WP) Third Year

Duration: 3 Hours

Course Code: PC-BTM601

B. Tech W.P

Maximum Points: 100

Course Name: Refrigeration and Air-Conditioning.

Semester: VI

Instructions:

01/06/2026

- 1) Question number ONE is compulsory and solve any FOUR questions out of remaining SIX
- 2) Use of refrigerant properties table and psychrometric chart is permitted.
- 3) Use of steam table is permitted.
- 4) Assume suitable data, mention it and justify the same.

Q.No.	Questions	Points	CO	BL	Module Number
1(a)	Draw a neat sketch of schematic diagram and T-s diagram of Regenerative aircraft refrigeration cycle.	2+2	1	1	1
1(b)	Derive an expression for the maximum COP of heat operated refrigeration machine.	5	1	1	3
1(c)	Effect of condenser pressure and evaporator pressure on the working of vapour compression refrigeration cycle.	3+3	3	1	1
1(d)	Explain the designation system for all the types of refrigerants.	5	1	1	2
2(a)	Explain in detail the Ozone Depletion Potential (ODP) and Global Warming Potential (GWP) of refrigerants. Explain the reaction happening during the ozone depletion. Also write about causes increasing GWP and remedial measures which can be taken to reduce GWP.	10	3	2	2
2(b)	A R-22 machine operates at -15°C evaporator and 35°C condenser temperature. Assuming a simple-saturation cycle, and by using R-134a refrigerants properties table, estimate the followings: (i) The compressor discharge temperature (ii) Work input to the compressor (iii) Refrigeration effect (iv) COP of the cycle (v) HP/TR.	10	1	3	1
3(a)	Describe the desirable properties of an ideal refrigerants.	10	3	1	2



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End Semester Examination May-2026/Re-Exam July 2026 (WP)

3(b)	Explain with neat sketch practical double-effect water-lithium bromide absorption chiller.	10	1	1,2	3
4(a)	Draw a neat sketch of the comfort chart and explain it in detail.	10	3	2	7
4(b)	A mixture of dry air and water vapour is at a temperature of 21°C under a total pressure of 98256 N/m ² . The dew-point temperature is 15°C. Find: (i) Partial pressure of water vapour (ii) Relative humidity (iii) Specific humidity (iv) Enthalpy of air per kg of dry air (v) Specific volume of air per kg of dry air.	10	2	3,4	4
5	A building has the following calculated cooling loads: Room sensible heat gain = 310 kW Room latent heat gain = 100 kW The space is maintained at DBT of 25°C and relative humidity of 50 %. The outdoor air is at 38°C and 50% R.H. And 10 % by mass of air supplied to the building is outdoor air. If the air supplied to the space is not at temperature lower than 18°C. Find (i) Minimum amount of air supplied to space in m ³ /s. (ii) Volume flow rates of return air and outdoor air (iii) State and volume flow rate of air entering the cooling coil. (iv) Capacity, ADP, BPF and SHF of the cooling coil. (Attach the psychrometric chart with sketch).	20	4	3,4	5
6(a)	Explain duct design methods.	10	2	1,2	7
6(b)	Explain with neat sketch the three fluid refrigeration system in VARS.	10	1	1,2	2
7.	Write short notes on the followings: (i) Mathematical model of heat exchange between man and environment. (ii) Liquid vapour regenerative heat exchanger in VCRS. (iii) Thermodynamic wet bulb temperature. (iv) Circular equivalent of rectangular duct.	20	1,3	1,2	1,4,6,7



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End Semester Examination/ Re-Examination, May / ~~June~~ 2026

Program: Third Year B.Tech. in Mechanical Engineering

Course Code: PC-BTM603

Course Name: Manufacturing Planning and Control

Duration: 03hrs.

Maximum Points:100

Semester: VI

Instructions:

1. Question 1 is compulsory.
2. Solve any 4 questions from remaining.
3. Assume Suitable Data wherever required.

03/06/2026

Question No		Maximum Marks	Course Outcome Number	Module No.																																								
Q1A	State the Salient Features 1. Market Survey and Forecasting 2. Capacity Planning 3. Manufacturing Requirement Planning 4. Material Requirement Planning 5. Master Production Scheduling	10	CO1 CO2 CO3	M1 M3 M4 M5																																								
Q1B	Refer the Following Manufacturing Scenario of three machines and 7 jobs. 10 Table shows the time required to process each job on the respective machine in min. Find the optimal sequence of jobs. Find Idle Time for each machine. Find Min Total Elapsed time. <table border="1"><thead><tr><th></th><th colspan="7">JOB</th></tr><tr><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th></tr></thead><tbody><tr><td>Machine M1</td><td>10</td><td>7</td><td>6</td><td>5</td><td>7</td><td>9</td><td>4</td></tr><tr><td>Machine M2</td><td>6</td><td>7</td><td>10</td><td>6</td><td>5</td><td>4</td><td>8</td></tr><tr><td>Machine M3</td><td>10</td><td>14</td><td>12</td><td>14</td><td>11</td><td>12</td><td>13</td></tr></tbody></table> State the seven waste as per JIT philosophy.		JOB								A	B	C	D	E	F	G	Machine M1	10	7	6	5	7	9	4	Machine M2	6	7	10	6	5	4	8	Machine M3	10	14	12	14	11	12	13	10	M4	CO2 CO3
	JOB																																											
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Machine M1	10	7	6	5	7	9	4																																					
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Machine M3	10	14	12	14	11	12	13																																					

Q2A	<table><tr><th>Production facility P_i / City demand D_i</th><th>P1</th><th>P2</th><th>P3</th><th>P4</th><th>Product Demand</th></tr><tr><td>D1</td><td>21</td><td>22</td><td>23</td><td>22</td><td>27</td></tr><tr><td>D2</td><td>18</td><td>23</td><td>21</td><td>15</td><td>16</td></tr><tr><td>D3</td><td>22</td><td>18</td><td>22</td><td>19</td><td>17</td></tr><tr><td>D4</td><td>23</td><td>21</td><td>24</td><td>19</td><td>21</td></tr><tr><td>D5</td><td>21</td><td>24</td><td>21</td><td>22</td><td>12</td></tr><tr><td>Supply Capacity</td><td>20</td><td>16</td><td>25</td><td>32</td><td>93</td></tr></table> Transportation Problem : A Ice cream manufacturing company has four production plants P 1,P2,P3,P4 with production capacity of 20,16,25,32 (1000) liters per day of a product respectively. These units are expected to be shipped to 5 cities D1,D2,D3,D4,D5 with requirements of 27,16,17,21,12 in (1000) liters per day respectively. The transportation cost in Rs per unit between factories and cities are given in table. Formulate LPP to Find the Min Cost of Transportation. Use NWCM to find initial basic solution to the transportation problem. Use LCM to find initial basic solution to the transportation problem. Find percentage reduction in transportation cost.	Production facility P_i / City demand D_i	P1	P2	P3	P4	Product Demand	D1	21	22	23	22	27	D2	18	23	21	15	16	D3	22	18	22	19	17	D4	23	21	24	19	21	D5	21	24	21	22	12	Supply Capacity	20	16	25	32	93	10	M7	CO1 CO2
Production facility P_i / City demand D_i	P1	P2	P3	P4	Product Demand																																									
D1	21	22	23	22	27																																									
D2	18	23	21	15	16																																									
D3	22	18	22	19	17																																									
D4	23	21	24	19	21																																									
D5	21	24	21	22	12																																									
Supply Capacity	20	16	25	32	93																																									
Q2A	A company manufactured around 210scooters. Depending upon the availability of production resources daily production varies between 205to 213 mopeds, whose probability distribution is as follows: <table><tr><th>Production per day</th><td>205</td><td>206</td><td>207</td><td>208</td><td>209</td><td>210</td><td>211</td><td>212</td><td>213</td></tr><tr><th>Probability</th><td>0.05</td><td>0.09</td><td>0.12</td><td>0.14</td><td>0.2</td><td>0.15</td><td>0.11</td><td>0.08</td><td>0.06</td></tr></table> The finished scooters are transported in special lorry with 210 mopeds capacity. Use following random number array: 82,89,78,24,53,61,18,45,04,23,50,77,27.54 and 10, simulate the process. Find average number of mopeds waiting in factory, Average waiting space in lorry. State the limitations of simulation technique.	Production per day	205	206	207	208	209	210	211	212	213	Probability	0.05	0.09	0.12	0.14	0.2	0.15	0.11	0.08	0.06	10	M7, M3	CO1, CO2, CO3																						
Production per day	205	206	207	208	209	210	211	212	213																																					
Probability	0.05	0.09	0.12	0.14	0.2	0.15	0.11	0.08	0.06																																					
Q2B	Refer the Project Data as given in a table .The time estimates in weeks for PERT network of project are as follows <table><tr><th>Activity</th><th>to</th><th>tm</th><th>tp</th></tr><tr><td>1-2</td><td>2</td><td>4</td><td>9</td></tr><tr><td>1-3</td><td>3</td><td>6</td><td>10</td></tr><tr><td>1-4</td><td>2</td><td>4</td><td>11</td></tr><tr><td>2-5</td><td>3</td><td>5</td><td>7</td></tr><tr><td>3-5</td><td>4</td><td>6</td><td>14</td></tr><tr><td>4-6</td><td>5</td><td>7</td><td>11</td></tr><tr><td>5-6</td><td>4</td><td>8</td><td>15</td></tr></table> Draw e project network. Find critical path. Compute the standard deviation and variance of the project length. What is the probability that the project will be completed atleast 2 week earlier than expected time.	Activity	to	tm	tp	1-2	2	4	9	1-3	3	6	10	1-4	2	4	11	2-5	3	5	7	3-5	4	6	14	4-6	5	7	11	5-6	4	8	15	10	M5	CO1, CO3										
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Q3A	Derive an expression for Economic Order Quantity of the (Basic model) of inventory. Derive an expression for Economic Batch Quantity of the of inventory. Explain the various Costs involved in inventory management.	10	M3	CO2, CO4																													
Q3B	Illustrate the Least Square method of Sales Forecasting with suitable 10 Example. State and explain the types of error in forecasting.	10	M1	CO1, CO2																													
Q4A	What are the factors affecting under capacity planning and over capacity planning?	10	M5	CO2, CO4																													
	<table><tr><td>Week</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>Requirements</td><td>200</td><td>400</td><td>900</td><td>500</td><td>200</td><td>200</td><td>200</td><td>1400</td></tr></table>				Week	1	2	3	4	5	6	7	8	Requirements	200	400	900	500	200	200	200	1400											
Week	1	2	3	4	5	6	7	8																									
Requirements	200	400	900	500	200	200	200	1400																									
Q4A	The annual demand for this end item is estimated to be 25,000 units over a 50 week per year schedule, or an average of 500 units per week. It costs Rs. 800 to change over the machines in the final assembly department to this end item when a production lot is begun. It costs Rs. 1.10 per unit when one unit of this product must be carried in inventory from one week to another; therefore, when one unit of this product is in ending inventory, it must be carried over as beginning inventory in the next week and incurs the Rs. 1.10 per unit carrying cost. Determine which of these lots sizing methods results in the least carrying and changeover (or order) costs for the eight week schedule: I (a) Lot for Lot (LFL), (I) Economic Order Quantity (EOQ).																																
Q4B	A project has following data.	10	M5	CO1, CO2 CO3																													
	<table><tr><td>Activity</td><td>Immediate Predecessor</td><td>Duration</td></tr><tr><td>A</td><td>-</td><td>6</td></tr><tr><td>B</td><td>-</td><td>4</td></tr><tr><td>C</td><td>A,B</td><td>9</td></tr><tr><td>D</td><td>B</td><td>5</td></tr><tr><td>E</td><td>A</td><td>7</td></tr><tr><td>F</td><td>C</td><td>5</td></tr><tr><td>G</td><td>E,F</td><td>4</td></tr><tr><td>H</td><td>D,F</td><td>5</td></tr><tr><td>I</td><td>G,H</td><td>9</td></tr><tr><td>J</td><td>I</td><td>5</td></tr></table>				Activity	Immediate Predecessor	Duration	A	-	6	B	-	4	C	A,B	9	D	B	5	E	A	7	F	C	5	G	E,F	4	H	D,F	5	I	G,H
Activity	Immediate Predecessor	Duration																															
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F	C	5																															
G	E,F	4																															
H	D,F	5																															
I	G,H	9																															
J	I	5																															
Q5A	1.Draw Project Network. 2.Find Duration Find all paths 3.Find Critical Path 4.Find E and L for each event. 5. Find EST, EFT,LST,LFT for each activity 6. Find Float for each activity. 7. State the purpose of finding critical path and float. Refer the following production situation.	10	M6	CO1, CO2, CO3																													

Machine	Product			Time Available per Week (Minute)	Cost/week at full capacity (Rs.)
	P1	P2	P3		
A ₁	4	6	-	4500	260
A ₂	5	9	10	95000	510
A ₃	7	8	-	7500	410
B ₁	8	-	-	3500	210
B ₂	3	8	7	5100	290
Material Cost(Rs.)	0.35	0.45	0.55		
Sale Price(Rs.)	1.60	1.70	2.20		

A firm produces three different products P1, P2 and P3. Each product needs to be processed through two departments, A and B. Department A has three machine A₁, A₂, and A₃ while B has two Machine B₁, B₂. Product 1 can be manufactured on any type of A and B machines. Product 2 can be manufactured on A machine and Only on B₂ of B type machines. Product 3 can be manufactured on machines A₂ of type A and B₂ of type B. time taken to manufactured. One unit of each of product on each type of machine is given below. I Formulate the L.P. model to maximize the profit.

The oil India is considering whether to go for an offshore oil drilling 10 contract to be awarded in Mumbai High. If they Bid value would be Rs 600 million with 65% chance of gaining the contract. They may set up a new drilling operation or move already existing operation which has proved successful to new site. The Probability of success and expected returns are as follows.

Outcome	New Drilling Operation		Existing Drilling Operation	
	Probability	Expected Revenue In Rs Millions	Probability	Expected Revenue In Rs Millions
Success	0.75	800	0.85	700
Failure	0.25	200	0.15	350

If the corporation do not bid or lose the contract they can use Rs 600 million to modernise their operations.

- This would result in return of 5% or 8% on sum invested with probabilities 0.45 and 0.55
- Construct the Decision Tree and Give your recommendation to Oil India Corporation.

Five Jobs 1,2,3,4,5 are to be assigned to 5 machines M₁, M₂, M₃, 10 M₄, M₅. The cost of assigning these jobs to machines in Rupees is given in the following matrix. Find The optimal Assignment and total cost of Assignment

10

M5
M6

CO2
CO4

Q5B

Q6A

10

M7

CO2

Jobs	M1	M2	M3	M4	M5
1	6	7	5	9	4
2	7	5	10	9	6
3	5	4	3	6	5
4	8	3	5	6	4
5	4	7	5	6	6

Q6B

A firm assembles and sells two different types of motors, A and B, using four resources. The production process can be described as follows:

Resources			Capacity per month
Motor unit shop resource			350 Type A units or 250 Type B units Or any linear combination of the two .
Type A gear and drive shop resources			225 Type A units
Type B gear and drive shop resources			175 Type B units
Final assembly resources			250 Type A units or 200 Type B Units Or any linear combination of the two

Type A units bring in a profit of Rs.110 each and type B units, Rs.90 each. What should be the optimum product mix? Solve Graphically. State the applications of LPP.

Q7A

A company invests in advertisement in its 12 units. Advertise investment X and sales revenue Y is shown in table. Obtain a Line of Best Fit (regression line) for the data, and predict sales revenue of unit with \$28 million in investment. All figures are in millions of dollars.

10

M5
M6
M7
M6

CO3
CO2

10

M1,M2
M3,M
4 M5,
M6
M7

CO1,
CO2

Units	Advertise investment in Dollars (x)	Sales Revenue in Dollars (y)
1	10	0.19
2	5	0.14
3	9	0.17
4	7	0.19
5	17	0.29
6	18	0.31
7	19	0.28
8	15	0.24
9	17	0.31
10	23	0.48
11	18	0.38
12	10	0.21

Explain Least Square method used in Sales/ Demand forecasting with the help of neat sketch.

Q7B

Write Short Notes on 1. Functions of MPC 2. Technologies used in Materials Management 3. Master Production Schedule 4. Under Capacity Planning and Over Capacity Planning.

10

M1,M2,
M3,M4
M5, M6
M7

COI



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END SEM/RE-ENTRY EXAMINATION MAY/JUNE 2026 (WP)

Program: BTECH (MECH.ENGG.) Third Year B.Tech Duration: 3 hrs

Course Code: MI-BT022

W.P

Maximum Points: 100

Course Name: Artificial Intelligence and Machine Learning

Semester: VI

05/06/2026

Q.No.	Questions	Points	CO	BL	Module No.
Q.1 (a)	Explain the working of the Linear Regression algorithm with the help of: • Linear regression equation • Cost/Loss function • Best fit line concept • Gradient descent optimization Also explain how the model updates its parameters during training to minimize prediction error.	10	1,2	2	3
(b)	Explain the working of the Logistic Regression algorithm with the help of: • Linear combination equation • Sigmoid function • Loss function • Gradient descent optimization Also explain how the model updates its parameters during training	10	1,2	2	3
Q.2 (a)	Explain the following AI algorithms (Any two) 1] Breadth first search 3] Uniform Cost search 4] Heuristic informed search algorithm - Explain supervised, Unsupervised and reinforcement learning with examples.	05 05	1,2	2	1
(b)	-What is Principal Component Analysis (PCA)? Explain the step-by-step procedure of PCA and discuss its applications in feature reduction and dimensionality reduction. -Explain different Model Evaluation Metrics such as Accuracy, Precision, Recall, F1-Score, MAE, MSE, and RMSE with suitable examples.	10	1,2	2	2
Q.3 (a)	The following dataset shows whether a machine failure occurs based on Temperature and Vibration conditions.	10	1,2	2	2



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	<table><tr><th>Machine</th><th>Temperature</th><th>Vibration</th><th>Failure</th></tr><tr><td>M1</td><td>High</td><td>High</td><td>Yes</td></tr><tr><td>M2</td><td>High</td><td>Low</td><td>Yes</td></tr><tr><td>M3</td><td>Low</td><td>High</td><td>No</td></tr><tr><td>M4</td><td>Low</td><td>Low</td><td>No</td></tr><tr><td>M5</td><td>High</td><td>High</td><td>Yes</td></tr><tr><td>M6</td><td>Low</td><td>High</td><td>No</td></tr></table> Using the Naïve Bayes Classification algorithm, predict whether the machine will fail for the following new condition: Temperature = High, Vibration = Low Perform the following steps: • Calculate prior probabilities • Calculate conditional probabilities • Apply Bayes' theorem • Compute posterior probabilities • Classify the new data sample into the appropriate class.	Machine	Temperature	Vibration	Failure	M1	High	High	Yes	M2	High	Low	Yes	M3	Low	High	No	M4	Low	Low	No	M5	High	High	Yes	M6	Low	High	No				
Machine	Temperature	Vibration	Failure																														
M1	High	High	Yes																														
M2	High	Low	Yes																														
M3	Low	High	No																														
M4	Low	Low	No																														
M5	High	High	Yes																														
M6	Low	High	No																														
(b)	Explain the applications of Artificial Intelligence (AI) and Machine Learning (ML) in Electrical Engineering with respect to smart grids and fault detection & diagnosis. Discuss the role of AI in improving reliability, energy management, and system performance.	10	1,2	2	2																												
Q.4 (a)	Explain the concept of Generative Adversarial Networks (GANs). Discuss the roles of Generator and Discriminator networks and explain the training process of GANs. along with neat figures	10	1,2	2	2																												
(b)	-Explain the concept of Bias in Artificial Intelligence. Discuss different sources of bias in AI systems and their impact on engineering and society. -Discuss the importance of Transparency and Accountability in AI Systems. Explain the challenges associated with explainable AI and ethical decision-making.	10	1,2	2	2																												



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Q.5 (a)	Explain the working of the K-Nearest Neighbors (KNN) classification algorithm with the help of: •Distance measurement techniques • Selection of nearest neighbors • Majority voting mechanism • Effect of K value on model performance Also explain how KNN classifies a new data sample during prediction. Draw suitable figures wherever required	10	1,2	2	2																																			
(b)	Explain the working of the K-Means Clustering algorithm with the help of: •Selection of K cluster centroids •Distance-based data point assignment •Centroid update mechanism •Iterative clustering process Also explain how the algorithm minimizes intra-cluster distance during training. Draw suitable figures wherever required.	10	1,2	2	2																																			
Q.6	A manufacturing company wants to classify machine components as Defective or Non-Defective using the Random Forest Algorithm. The following dataset is given: <table><tr><th>Component</th><th>Temperature</th><th>Vibration</th><th>Pressure</th><th>Condition</th></tr><tr><td>C1</td><td>High</td><td>High</td><td>Low</td><td>Defective</td></tr><tr><td>C2</td><td>High</td><td>Low</td><td>Low</td><td>Defective</td></tr><tr><td>C3</td><td>Low</td><td>High</td><td>High</td><td>Non-Defective</td></tr><tr><td>C4</td><td>Low</td><td>Low</td><td>High</td><td>Non-Defective</td></tr><tr><td>C5</td><td>High</td><td>High</td><td>High</td><td>Defective</td></tr><tr><td>C6</td><td>Low</td><td>High</td><td>Low</td><td>Non-Defective</td></tr></table> A new component has: • Temperature = High • Vibration = High • Pressure = Low Random Forest generates 3 decision trees.	Component	Temperature	Vibration	Pressure	Condition	C1	High	High	Low	Defective	C2	High	Low	Low	Defective	C3	Low	High	High	Non-Defective	C4	Low	Low	High	Non-Defective	C5	High	High	High	Defective	C6	Low	High	Low	Non-Defective	20	1,2	2	2
Component	Temperature	Vibration	Pressure	Condition																																				
C1	High	High	Low	Defective																																				
C2	High	Low	Low	Defective																																				
C3	Low	High	High	Non-Defective																																				
C4	Low	Low	High	Non-Defective																																				
C5	High	High	High	Defective																																				
C6	Low	High	Low	Non-Defective																																				



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	Tasks 1. Create bootstrap sample datasets for Tree 1, Tree 2, and Tree 3. 2. Randomly select any two features for each tree. 3. Using the sampled datasets and selected features, predict the class of the new component for each tree. 4. Determine the final prediction using majority voting. 5. Explain how Random Forest reduces overfitting compared to a single Decision Tree.				
Q.7 (a)	Explain the architecture and working of a Convolutional Neural Network (CNN) with suitable diagram. Discuss the functions of convolution layer, pooling layer, and fully connected layer, and explain the applications of CNN in image processing and engineering systems..	10			
(b)	Discuss the applications of Artificial Intelligence and Machine Learning (AI/ML) in Mechanical Engineering. Explain how AI/ML techniques are used in predictive maintenance, smart manufacturing, quality control, robotics, thermal systems, design optimization, Digital Twins, and autonomous industrial systems with suitable examples.	10	4	2	2

***** ** ALL THE BEST *****